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November 1990

USAID AND NOAA FISHERIES WORKSHOP ON PLANNING A SYSTEM OF FISH AGGREGATING DEVICES (FADS) FOR LESS DEVELOPED COUNTRIES

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Samuel G. Pooley and Christofer H. Boggs

Honolulu Laboratory
Southwest Fisheries Science Center
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96822-2396

ADMINISTRATIVE REPORT H-90-15

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Southwest Fisheries Science Center
Administrative Report H-90-15

USAID AND NOAA FISHERIES WORKSHOP ON PLANNING A SYSTEM OF FISH AGGREGATING DEVICES (FADS) FOR LESS DEVELOPED COUNTRIES

Samuel G. Pooley and Christofer H. Boggs
Southwest Fisheries Science Center Honolulu Laboratory
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96822-2396

November 1990

NOT A PUBLICATION

PREFACE

This report was prepared in the context of a joint planning exercise with the U.S. Agency for International Development (USAID) and NOAA Fisheries. The report represents a preliminary step in the planning process which has continued within USAID. This report does not represent the policy conclusions of USAID nor NOAA Fisheries, and it is not a complete technical presentation of the issues involved in the development of a program of fish aggregating devices (FADs). The report is issued because we believe an easily accessible document outlining important steps in the planning and implementation of a system of FADs would be useful.

Samuel G. Pooley
Christofer H. Boggs

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ABSTRACT

This report summarizes the results of a 3-day planning workshop held to help design a program for introducing self-sustaining fish aggregating devices (FADs) in less developed countries. The workshop was a facilitated, interactive group planning process in which expert participants were asked to identify key barriers to the development of a FAD program and to outline the kinds of activities required to overcome those barriers. The results of this workshop provide an overview of the myriad steps which must be considered in the planning and implementation of a FAD program.

WORKSHOP ANNOUNCEMENT

Planning the Introduction of Fish Aggregating Devices into Small-Scale Fisheries

USAID and NOAA Fisheries

PLANNING WORKSHOP

WHAT: A facilitated, multidisciplinary planning workshop to help develop a program of self-sustaining fish aggregating devices (FADs) in less developed countries.

WHO:

Convener: Dr. George Boehlert
Director, Honolulu Laboratory
Southwest Fisheries Science Center
National Marine Fisheries Service
(NOAA Fisheries)

Coordinators: Dr. Sam Pooley and Dr. Chris Boggs
Honolulu Laboratory

Facilitator: Mr. Dave Mackett
Planning Officer
Southwest Fisheries Science Center
La Jolla, Calif.

Participants: Invited experts and observers

WHEN: June 7-9, 1989

WHERE: Honolulu Laboratory
National Marine Fisheries Service
2570 Dole Street
Honolulu, HI 96822-2396
Telephone: (808) 943-1221
FAX: (808) 942-2062

WHY: The National Marine Fisheries Service, Office of International Affairs, has agreed to assist the U.S. Agency for International Development in the design of projects for self-sustaining FADs in less-developed countries. The Honolulu Laboratory, NMFS, has considerable experience in the development of FADs and has agreed to facilitate this stage of the program. The workshop will identify the key steps necessary to accomplish this program and will be the major

ingredient in the preparation of a project identification document.

HOW: Facilitated, consensus-seeking meetings will be held to specify objectives, explore relationships between objectives, develop options for implementing the project, and identify criteria for selecting project sites.

WORKSHOP AGENDA

Wednesday, June 7, 1989

8:30 am	Welcome and Introductions -- Pooley, HL -- Jones, USAID
8:45 am	Agenda and meeting objectives -- Mackett, SWFSC
9:00 am	Goal of program (clarification)
9:15 am	FAD experiences -- Workshop participants
9:45 am	Identification of project design barriers
1:30 pm	Interrelationship between barriers

Thursday, June 8, 1989

8:00 am	Review of previous day's work
9:00 am	Identification of activities for overcoming barriers
1:30 pm	Development of an "options field" of activities

Friday, June 9, 1989

8:30 am	Review of previous day's work
9:00 am	Continuation of options field
1:45 pm	Structuring options field categories
2:30 pm	Criteria for site selection
3:00 pm	What's next? -- Pooley
3:15 pm	Wrap-up and workshop evaluation -- Mackett and participants

INTRODUCTION

This report presents the results of a workshop convened by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) as one step in designing a program for introducing fish aggregating devices (FADs) into less developed countries (LDCs) with small-scale fisheries. The FAD program,[1] if approved, would be implemented by the U.S. Agency for International Development (USAID). The design process included two phases: a preliminary program design phase and a site-specific project design and implementation phase. The NOAA Fisheries Office of International Affairs (NOAA F/IA) agreed to conduct the program design and assist in the site-specific project design. The workshop was conducted by the NMFS Southwest Fisheries Science Center (SWFSC) at its Honolulu Laboratory (HL).

The overall planning process is outlined in Figure 1 which depicts the agencies responsible for the implementation and planning steps during this phase of the program. Arrows represent the flow of key planning documents through these agencies. A number of key planning documents are included in the program planning process: the program "concept paper" prepared by NOAA F/IA, the present report, and a project identification document (PID) prepared by a consultant for USAID-NOAA Fisheries. The PID is the basic decision document used by U.S. AID. The concept paper proposed a program to

> initiate sustained self-help efforts among small-scale 'artisanal' fishermen through the introduction of fish aggregating devices (FADs) into rural fishing communities . . . . Project goals are directly related to [U.S.] AID goals of increasing income of the poorest segments of the population, increasing consumption of high protein food among target groups, and managing natural resources to permit sustained use at optimum levels (NOAA F/IA 1989).

The present report records the contributions of the workshop participants toward outlining this program and extends their contributions by developing some preliminary detail toward such a program.

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[1]We make the semantic distinction of calling the design and funding steps the "program," whereas the implementation of that program in the field is conducted through "projects." Naturally, these definitions occasionally overlap.

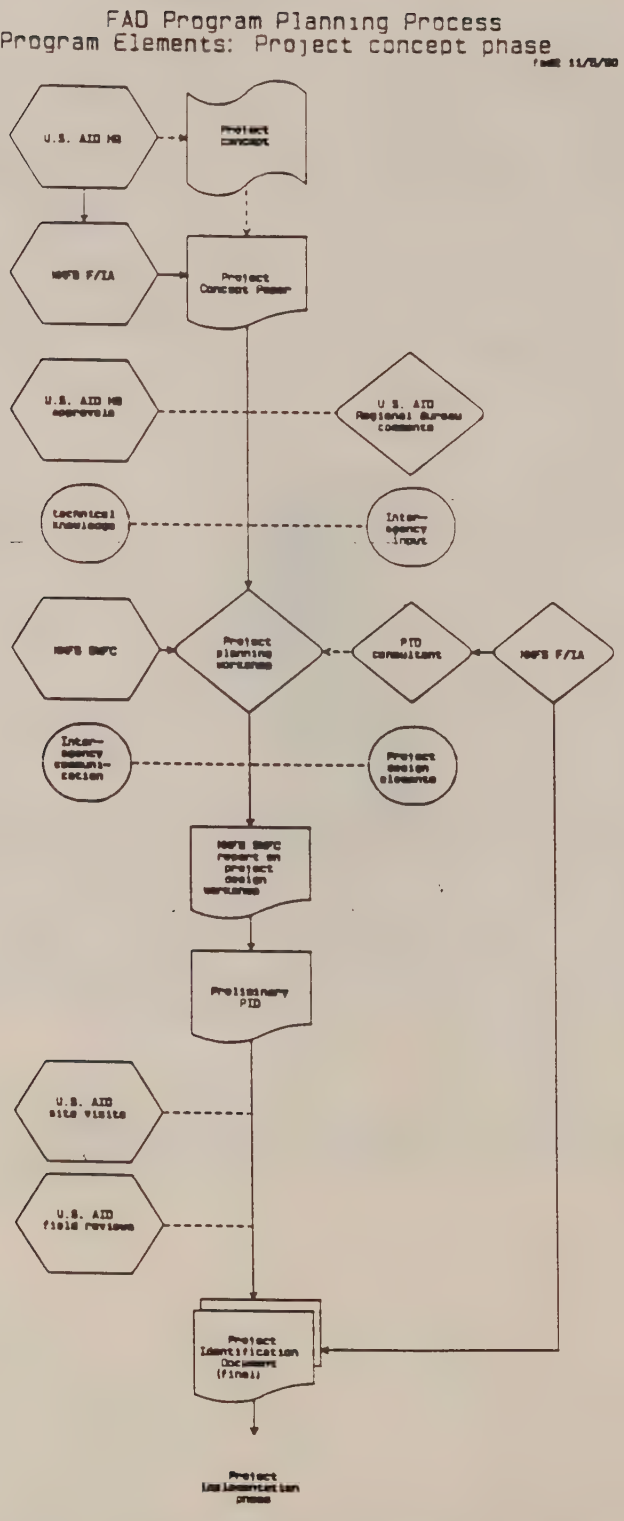

Figure 1.--FAD planning process.

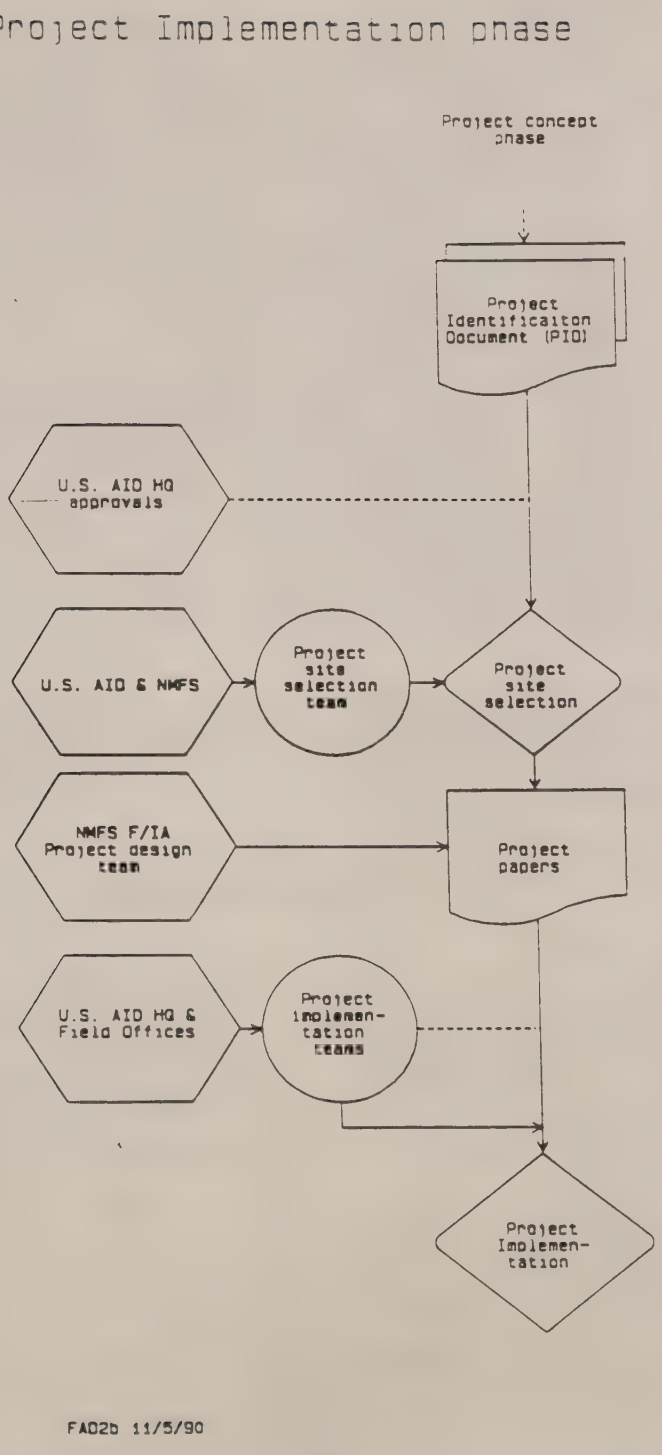

Figure 1.--Continued.

WORKSHOP PROCESS

The NMFS SWFSC has used a facilitated, interactive, structured planning approach for over 10 years in designing complex research projects. The planning framework consists of three elements: context, process, and content. The context is framed by the sponsors of the plan; the process is an interactive, structured planning approach using a trained facilitator; and the content is provided by the workshop participants who are chosen for their expertise or, in some cases, are chosen primarily because they are major constituents or stakeholders in the planning outcomes. The interactive planning process is described in Mackett (1983). Major outputs of this planning process are the building of a common knowledge base amongst participants and a consensus on policy directions (especially important when dealing with key participants in a planning process) and the identification of key points of concern for the planning and implementation process. The latter is usually recorded as a nearly verbatim transcript of answers to the trigger questions posed during the workshop. This report differs from the SWFSC norm by greater editorial license and technical contribution by the two authors. However, the responses of the participants to the trigger questions are reproduced faithfully.

The workshop took place 7-9 June 1989 in Honolulu, Hawaii (see Workshop Announcement and Workshop Agenda). There were 10 participants and 3 observers, as well as 2 workshop coordinators and a facilitator:

Workshop Participants

Christofer H. Boggs
(*Coordinator*)
Fishery Biologist
Southwest Fisheries Science
Center, Honolulu Laboratory
NMFS, NOAA
2570 Dole Street
Honolulu, HI 96822-2396
(808) 943-1222

Lt. Richard Boy
Ocean Engineer
U.S. Coast Guard (G-ECV-3)
2100 2nd St., S.W.
Washington, D.C. 20593-0001
(202) 267-1899

Steve Drew
Fisheries Development
Specialist
65 Flint Locke Drive
Plymouth, MA 02360
(508) 830-0910

William Gibbons-Fly (*Observer*)
Formerly: Foreign Affairs Specialist, Office of International Affairs, NMFS, NOAA
Currently: Office of Fisheries Affairs, Bureau of Oceans and International Environmental and Scientific Affairs
U.S. Department of State
Washington, D.C. 20520
(202) 647-3940

Glenn Higashi
Fishery Biologist
Division of Aquatic Resources
Hawaii Department of Land and Natural Resources (HDLNR)
1151 Punchbowl Street
Honolulu, HI 96813
(808) 548-3044

Kim N. Holland
Fishery Biologist
Hawaii Institute of Marine Biology
P.O. Box 1346, Coconut Island
Kaneohe, HI 96744
(808) 247-6631

Chris R. Jones
Fishery Biologist (*Observer*)
Agency for International Development
ST/AGR Rm. 406, SA-18
Washington, D.C. 20523
(703) 875-4016

Alvin Z. Katekaru
Fishery Biologist
Formerly: Division of Aquatic Resources, HDLNR
Now: Fisheries Management Specialist
Pacific Area Office
Southwest Region, NMFS, NOAA
2570 Dole Street
Honolulu, HI 96822-2396
(808) 551-2927

David J. Mackett (*Facilitator*)
Planning Officer
Southwest Fisheries Science Center, NMFS, NOAA
P.O. Box 271
La Jolla, CA 92038
(619) 546-7069

Mary E. Mozynski (*Observer*)
Program Officer
Agency for International Development
STT/AGR, Rm. 406, SA-18
Washington, D.C. 20523
(703) 875-4233

Richard B. Pollnac
Anthropologist
Sociology-Anthropology Dept.
University of Rhode Island
Kingston, RI 02881-0808
(401) 792-4140 - office
(401) 789-3243 - home

Samuel G. Pooley (*Coordinator*)
Economist
Southwest Fisheries Science Center, Honolulu Laboratory
NMFS, NOAA
2570 Dole Street
Honolulu, HI 96822-2396
(808) 943-1216

Harry Rea
Fishery Specialist
Peace Corps/OTAPS/E-8600
1990 K Street, N.W.
Washington, D.C. 20526
(202) 254-3402
(800) 424-8580, ext. 231

Karl C. Samples
Resource economist
Marine Resource Economics Research
92-671 Makakilo Drive, #29
Ewa Beach, HI 96707
(808) 941-3313

Richard S. Shomura
Researcher (Fisheries)
Hawaii Institute of Marine
Biology, University of Hawaii
P.O. Box 1346
Kaneohe, HI 96744
(808) 943-1229

Robert A. Skillman
Fishery Biologist
Southwest Fisheries Science
Center, Honolulu Laboratory
NMFS, NOAA
2570 Dole Street
Honolulu, HI 96822-2396
(808) 943-1257

Participants were provided the concept paper (NOAA F/IA 1989) and a preliminary workshop agenda which identified key components of the planning process, but otherwise they were not required to bring any technical material to the meeting or make any other preparations. The meetings lasted all day. Field trips to the State of Hawaii FAD shoreside work site and an offshore FAD site were arranged during the workshop. The NMFS HL took care of all logistical arrangements in Honolulu, and funding was provided by NMFS F/IA. The workshop was facilitated by Dave Mackett, SWFSC, who guided the participants through the planning process.

PROGRAM GOAL AND WORKSHOP OBJECTIVES

The workshop was held to assist in developing a FAD program. At the start of the workshop, the participants were asked to be sure that they understood the goal of the FAD[2] program:

> to design and implement a self-sustaining program utilizing fish aggregating devices (FADs) in less developed countries (LDC).

The objectives of the workshop were to

1. Understand the goal of the program;
2. Identify barriers to designing and executing the program, and to understand their interrelationships;
3. Identify activities to overcome these barriers;
4. Identify criteria for choosing sites for FAD projects.

The use of an interdisciplinary approach emphasizing the collective thinking of a variety of experts was an excellent way to identify the most important constraints to the deployment and

---

[2]"Program" used in the general sense for workshop purposes. The ultimate U.S. AID project "Program" may define other specific goals.

use of FADs. The wide range of expertise made it possible to identify a range of constraints, including biological, logistical, socioeconomic, and environmental constraints.

The participants represented a wide range of disciplines and experiences. Four participants (Jones, Mozynski, Rea, and Pollnac) were intimately knowledgeable about USAID planning processes. Five (Rea, Drew, Pollnac, Shomura, and Skillman) had wide field experience in fisheries projects in countries with small-scale fisheries. Two (Samples and Pollnac) had a social science orientation, whereas three (Boy, Higashi, and Katekaru) had immediate experience in designing and situating FADs. Two (Holland and Skillman) had considerable biological knowledge about fisheries associated with FADs. In addition, the two coordinators for the Honolulu Laboratory (Boggs and Pooley) had a multidisciplinary interest in FAD fisheries, although neither could be considered a FAD expert.

WORKSHOP ACCOMPLISHMENTS

Clarifications

The workshop began with a clarification of the stated goal of the USAID program. Chris Jones of USAID said that the function of the FAD program was to enhance small-scale fisheries in less developed and rural areas. USAID would be considering a broad range of countries in Southeast (SE) Asia, the Pacific islands, Central and South America, the Caribbean, Africa, and the Middle East as possible sites for implementing FAD projects. However, the choice of specific countries was not a topic covered at the workshop.

The issue of which level of government or institution would implement the project was raised. For example, a village, cooperative, nonprofit organization, or small company might install industrial-scale FADs for local use. National governments or large commercial enterprises could install FADs that might also be used by small-scale fishers. The economic self-sufficiency of the user group was considered important in relation to the ability of the program to be self-sustaining.

Finally, the definition of "self-sustaining" was clarified. A program that could be "self-propagating" would be ideal. A self-propagating program would be one that is sufficiently cost effective and has a level of technology that not only can be maintained but also expanded upon by the user group, or copied by similar user groups in other areas without any need for external support. In a self-sustaining program, USAID would not provide funds to maintain or replace FADs once they had been deployed. A limited start-up period of maintenance and replacement might be considered while the viability of the fishery is being established. FADs that will endure for many years with little

maintenance can be constructed, but it was agreed that, even though a program using such FADs might endure for some years, this would not constitute a self-sustaining program. Thus, mechanisms for generating funds for servicing and replacing FADs would be needed for a project to be self-sustaining. The funding for starting projects under this program would come from the regional AID missions, so the best chance at implementation would be for projects with small, initial funding requirements.

The general consensus was that the program goal--designing and implementing a self-sustaining program for FADs in less-developed countries--encompassed wide-ranging problems for which ready answers were not available. While many FAD programs have been tried around the world, evidently very few have been able to finance their maintenance and replacement directly from users of the FADs (i.e., there has been a need for an external infusion of funds). Furthermore, although considerable research exists on what FADs do in terms of attracting and holding fish, the fishery dynamics in each location are likely to be different, as are the socioeconomic conditions pertinent to the maintenance of a systems of FADs and their impact on existing fisheries and communities. Therefore, the first requirement of the planning process, which is the Honolulu Laboratory's contribution, was to set the stage for defining the parameters of the problem, rather than to compile and analyze existing information (a number of excellent references already are available, and many are cited in the References).

Exchange of Information

The next step in the workshop was a general exchange of information among participants on the lessons each had learned from FAD projects or fisheries development and research. This provided a background for the structured input portion of the workshop.

Richard Boy of the U.S. Coast Guard described some experiences gained as a consultant to the South Pacific Commission (SPC) which has been involved in many FAD projects. Institutions interested in FAD deployment in the South Pacific range from those with a lot of money to those seeking outside funding. Some have to make do with inexpensive, throw away technology. Thus, FAD design issues are complicated by the amount of resources that can be brought to bear, and there can be no "one-size-fits-all" solution. Design problems go beyond physics and economy to include human behavior. Some fishermen will cut FADs loose to keep newcomers out of a fishing ground; some will cover the lights used to locate FADs.

Robert A. Skillman of the NMFS Honolulu Laboratory made several points about the relationship of FADs to competition

between and within fisheries. When FADs are successful, they can generate conflicts between user groups. For example, commercial-scale vessels can remove the total aggregate of fish at a FAD in a very short time, thus leading to a pulse fishing strategy using several FADs. On the other hand, small-scale or artisanal fisheries might prefer a strategy more in tune with the rate of recruitment to "their" FADs. There can be "gear competition" among FADs just as among other fishing gears. When FAD density increases through additional deployments, existing FAD users (or non-FAD fishermen) may blame new, nearby FAD users for drawing off their resources. For example, inshore, (small-scale) deployers of FADs may perceive offshore (large-scale) deployers of FADs as intercepting their fish. There can be competition between the fish-attracting effect of several FADs, and the spatial deployment of the FADs will determine whose fish are affected. Institutions that have been involved in FAD deployment programs have had a hard time proving, even to themselves, that the programs are successful.

Steve Drew who had worked on FAD projects for the United Nations Food and Agriculture Organization (FAO) mentioned that a successful program in the Maldives ended when the FADs were not replaced after being blown away in a storm. A successful program is now under way in Mauritius. The FAO has produced a number of publications describing these and other FAD projects, so a lot of technical information is already available. Some of these publications are mentioned in the References to this report.

Al Katekaru formerly of the Hawaii Division of Aquatic Resources, and subsequently Glen Higashi of the same agency, directed the State of Hawaii's FAD program. Some FAD experiments in Hawaii were started by NMFS at six sites (off the islands of Oahu, Lanai, and Hawaii) in 1977. The State began implementing a FAD program on a statewide basis in 1979 as part of a major thrust to improve and further develop the local fisheries. In 1980 the program deployed 26 FADs, made of large rubber tires, at locations suggested by local fishermen. Over the last 10 years, the program has cost about $1.3 million to operate, maintain, and replace FADs. The program now includes 63 sites. The State is pursing the ideal FAD design to reduce losses, the most recent innovation being subsurface FADs that interfere less with navigation and are somewhat protected from rough seas and tampering.

Higashi and Katekaru pointed out that generally pelagic fishes (primarily tunas) caught at FADs are smaller than those caught away from FADs. User conflicts frequently arise at the FADs, but the competition for access is a sign of effectiveness therein. Fishermen at first were hesitant to change traditional practices of looking for pelagic (open ocean) fish schools, but they now quickly identify with the FADs in their area and complain vociferously if they are not replaced when lost. Hawaii has enacted laws on the use of FADS, such as prohibiting tying up

to any FAD (which causes failure of mooring systems). Catch reports are collected and analyzed to determine fishing success at the FADs. The FADs are successful and popular, and the program's popularity has motivated continued funding from State government sources.

Working with the NMFS Honolulu Laboratory, Kim Holland of the University of Hawaii, has tracked pelagic fishes (mostly tuna) caught at FADs. At the workshop, he described tracks that indicate tuna tend to make excursions averaging roughly 5 miles from a FAD and then return. As a commercial fisherman, Holland found that the FADs farther offshore consistently have more fish. Combining these insights, he suggested that the proximity of a FAD to another attractive feature, such as the 40-fathom contour of an island, increases the exchange of fish. Placing FADs more than 5 miles from the 40-fathom contour or from other FADs should cause fish to remain longer.

Richard Pollnac of the University of Rhode Island described a variety of experiences in SE Asia and the Pacific. In the Philippines, large fishing companies deploy FADs and then operate them in symbiosis with small-scale fishers who watch and protect the FADs in exchange for fishing access. Thus, FAD projects could be designed to benefit both large commercial and small-scale artisanal fisheries. In Indonesia as well, large companies maintain FADs, but small-scale fishermen have access to them. In some places, FADs are traditional fishing equipment. In Oman, FADs are constructed of brush and used in conjunction with fish traps. Traditional local materials are not always the most economical. For example, in the Philippines, bamboo prices have risen so that steel drums are now a cheaper flotation material.

According to theoretical work by Karl Samples of Marine Resource Economics Research, unregulated access to FADs does not improve the net economic efficiency of fisheries, relative to having no FADS at all. Conversely, managed access can improve the yield per effort in a fishery. Samples' empirical studies showed that FADs are incredibly popular but did not show that users would be willing to pay to maintain FADs, nor that the net benefits from using FADs are sufficient to offset the costs of their deployment.

Richard S. Shomura of the University of Hawaii and formerly Director of the NMFS Honolulu Laboratory described his ground-breaking experience with FADs in Hawaii. The FADs were a traditional fishing method in the Pacific but had not been tried in Hawaii where the winds and waves are strong. Biologists trying to be engineers installed FADs that were immediately successful in attracting fish but soon blew away. The FADs had to be specially designed for Hawaii's waters, and replacement costs remain substantial. Deployment of FADs funded by USAID in Western Samoa was very successful, and the traditional uses of

FADs in SE Asia and Indonesia are precedents for self-sustaining systems. Shomura emphasized that FADs work in some locations and not others and that success has come from aggregating pelagic fishes (compared with bottomfish, etc.). The biological impact of inshore deployment of FADs is not well known, but such FADs might negatively influence smaller species important in the food chain.

Barriers to Implementing and Sustaining a Program of FADs

The workshop moved on to identify barriers to designing and implementing a self-sustaining program for FADs in LDCs. Barriers were identified through the use of the nominal group technique, one of a number of consensus methodologies employed in this kind of planning (Delbeq et al. 1975). The trigger question for this part of the agenda was:

> **What are the significant and important barriers to establishing a program of self-sustaining FADs in less developed countries?**

There were 60 barriers identified, which we have categorized into 9 major groups.[3] Neither the barriers nor the groups are listed in priority order. (Appendix A provides a description of the barriers.)

Barriers

FAD construction and maintenance
- (1) FAD buoy and mooring design.
- (4) Availability of materials.
- (10) Fabrication skills.
- (15) Appropriate scale.
- (19) Service vessels.
- (28) Maintenance personnel.
- (35) Longevity of FADs.
- (36) Engineering and logistics feedback.
- (42) Vessels for deploying FADs.
- (55) Local manufacturing.

Social and economic environment
- (2) Marketing and social needs.
- (5) Conflicts due to access rights.
- (9) Local government support.

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[3]Although some barriers may appear to replicate others, each had a specific and separate meaning for the participant who proposed it. Although there are advantages to "aggregating" these suggestions, at this state in the planning process, it was felt that maintaining the original contributions was important.

(12) Navigational conflicts.
(14) Inequitable ownership patterns.
(18) Social dynamics.
(21) Resistance to government and fishery projects.
(32) Institutional appropriateness.
(33) Local government resistance.
(38) Lack of fishing traditions.
(51) Identification of ocean boundaries.

Fishing
(3) On-site expertise.
(7) Fishing boats and equipment.
(17) User groups.
(22) Conflict between fishing age groups.
(25) Conflict with existing fishery groups.
(30) Interference from foreign fishing fleets.
(34) FAD fishing techniques.
(44) Lack of FAD experience.
(45) Conflict between user groups.
(52) Appropriate technology.

Economic benefits
(6) Replacement costs.
(20) Project viability scale.
(46) System to estimate costs and benefits.
(48) Estimating project viability.

Project management
(8) Internal finance mechanism.
(13) On-site authority.
(23) Financial management system for replacement.

Program considerations
(49) USAID and government resistance to fishery projects.
(50) Level of USAID headquarters involvement.
(54) Environmental site selection criteria.
(55) Country selection criteria.
(61) Agencies for project implementation.

Biological environment
(11) Biological resource.
(16) Ecological impacts.
(29) Harvest capacity and number of boats.
(31) Conflict with marine mammals.
(37) Competition with other fishing sites.
(39) Impact of lost FADs.
(47) Capture of juvenile fish.

Oceanographic environment
(24) Appropriate locations.
(26) Oceanographic information.

Infrastructure and regulation

(40) Techniques to protect FADs.
(41) Marketing infrastructure.
(42) Regulating FAD use.
(56) Enforcement.
(58) Permits.
(59) Monitoring.
(60) Fisheries infrastructure.

After identification of barriers and discussion of their significance, the barriers were ranked in order of importance by the participants to focus the group's time on structuring the most important barriers. The following are the most highly ranked barriers (i.e., those barriers the workshop participants felt were the most significant constraints to developing a self-sustaining program of FADs): 1) needing a FAD buoy and mooring design (barrier 1); 2) lack of knowledge for selection of FAD sites to produce a suitable harvest (barrier 2); 3) negative ecological impacts (barrier 16); 4) lack of acceptance and endorsement of FAD program goals by government, as well as unrealistic expectations by the community of government assistance (barrier 9); 5) insufficient biological resource to support development (barrier 11); 6) lack of financial management systems to provide for preventive maintenance and repairs (barrier 23); and 7) inability to estimate the viability of the project (barrier 48).

Most of the ranked barriers were then linked into a logical structure or network using a computer-assisted, association technique called Interpretive Structural Modeling. The linking relationship was posed as follows:

> **In the context of designing and implementing a self-sustaining program of FADs in LDCs, would activities designed to overcome barrier... [A]...substantially help in the resolution of barrier...[B]?**

The most highly ranked barriers as voted by the participants were placed in the first barrier interrelationship network. The network as it was composed by the workshop participants is shown in Figure 2. The remaining barriers were entered into the "expanded" network by the workshop coordinators following the workshop (Fig. 3). The expanded network as prepared afterwards by the workshop coordinators is shown in Figure 3. Nonetheless, the next steps of the workshop were based solely on the structure composed by the participants (Fig. 2).

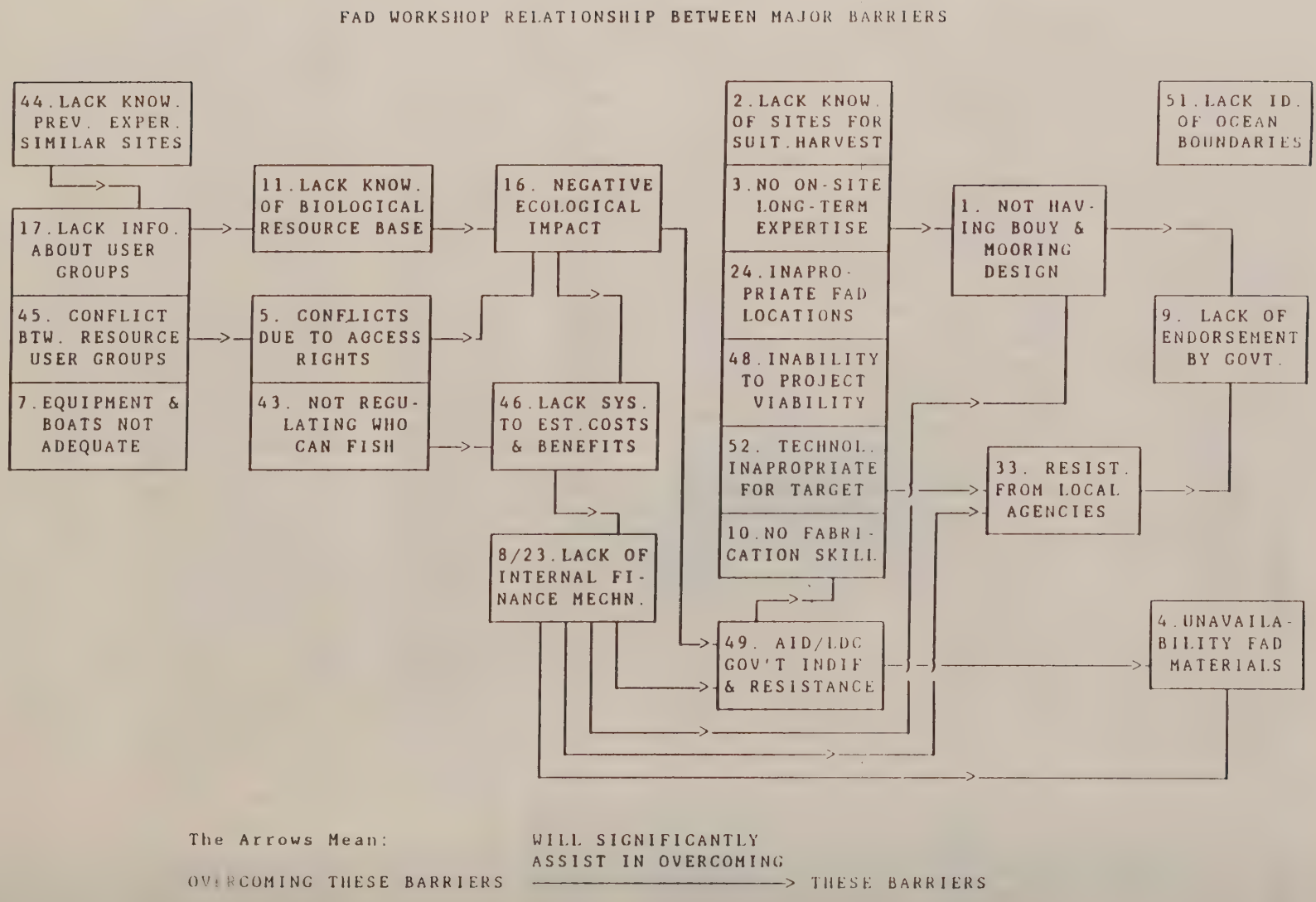
FAD WORKSHOP RELATIONSHIP BETWEEN MAJOR BARRIERS
44. LACK KNOW. PREV. EXPER. SIMILAR SITES
17. LACK INFO. ABOUT USER GROUPS
45. CONFLICT BTW. RESOURCE USER GROUPS
7. EQUIPMENT & BOATS NOT ADEQUATE
11. LACK KNOW. OF BIOLOGICAL RESOURCE BASE
5. CONFLICTS DUE TO ACCESS RIGHTS
43. NOT REGULATING WHO CAN FISH
16. NEGATIVE ECOLOGICAL IMPACT
46. LACK SYS. TO EST. COSTS & BENEFITS
8/23. LACK OF INTERNAL FINANCE MECHN.
2. LACK KNOW. OF SITES FOR SUIT. HARVEST
3. NO ON-SITE LONG-TERM EXPERTISE
24. INAPROPRIATE FAD LOCATIONS
48. INABILITY TO PROJECT VIABILITY
52. TECHNOL. INAPROPRIATE FOR TARGET
10. NO FABRICATION SKILL
49. AID/LDC GOV'T INDIF & RESISTANCE
51. LACK ID. OF OCEAN BOUNDARIES
1. NOT HAVING BOUY & MOORING DESIGN
9. LACK OF ENDORSEMENT BY GOVT.
33. RESIST. FROM LOCAL AGENCIES
4. UNAVAILABILITY FAD MATERIALS
The Arrows Mean:
OVERCOMING THESE BARRIERS
WILL SIGNIFICANTLY ASSIST IN OVERCOMING
THESE BARRIERS

Figure 2.--Network of interrelationships between major barriers--FAD workshop participants' contributions.

EXPANDED RELATIONSHIP OF BARRIERS

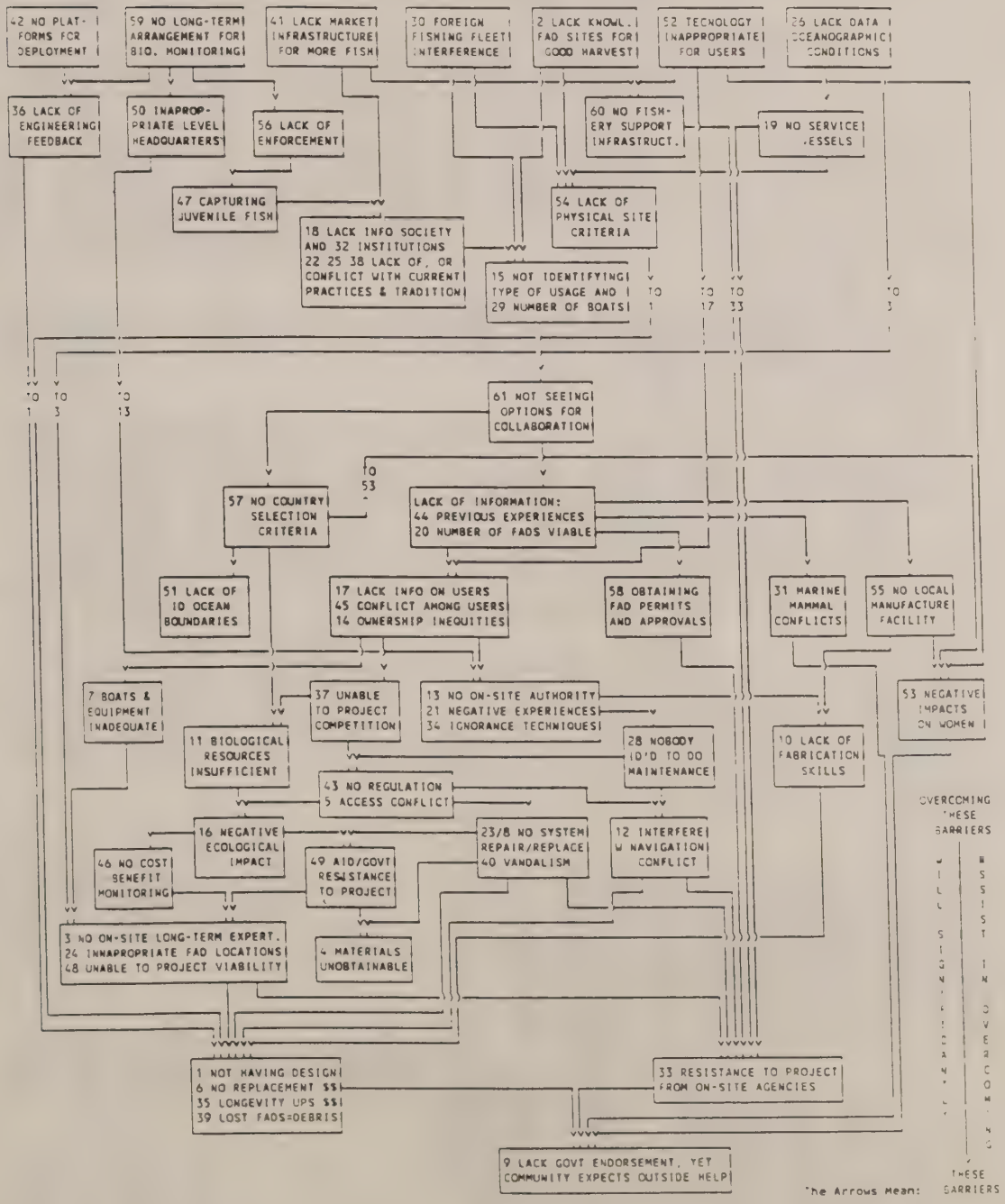
42 NO PLAT- FORMS FOR DEPLOYMENT
59 NO LONG-TERM ARRANGEMENT FOR BIO. MONITORING
41 LACK MARKET INFRASTRUCTURE FOR MORE FISH
30 FOREIGN FISHING FLEET INTERFERENCE
2 LACK KNOWL. FAD SITES FOR GOOD HARVEST
52 TECHNOLOGY INAPPROPRIATE FOR USERS
26 LACK DATA OCEANOGRAPHIC CONDITIONS
36 LACK OF ENGINEERING FEEDBACK
50 INAPROP- PRIATE LEVEL HEADQUARTERS
56 LACK OF ENFORCEMENT
60 NO FISH- ERY SUPPORT INFRASTRUCT.
19 NO SERVICE VESSELS
47 CAPTURING JUVENILE FISH
54 LACK OF PHYSICAL SITE CRITERIA
18 LACK INFO SOCIETY AND 32 INSTITUTIONS 22 25 38 LACK OF, OR CONFLICT WITH CURRENT PRACTICES & TRADITION
15 NOT IDENTIFYING TYPE OF USAGE AND 29 NUMBER OF BOATS
TO 1
TO 17
TO 33
TO 3
TO 1
TO 3
TO 13
61 NOT SEEING OPTIONS FOR COLLABORATION
TO 53
57 NO COUNTRY SELECTION CRITERIA
LACK OF INFORMATION: 44 PREVIOUS EXPERIENCES 20 NUMBER OF FADS VIABLE
51 LACK OF 10 OCEAN BOUNDARIES
17 LACK INFO ON USERS 45 CONFLICT AMONG USERS 14 OWNERSHIP INEQUITIES
58 OBTAINING FAD PERMITS AND APPROVALS
31 MARINE MAMMAL CONFLICTS
55 NO LOCAL MANUFACTURE FACILITY
7 BOATS & EQUIPMENT INADEQUATE
37 UNABLE TO PROJECT COMPETITION
13 NO ON-SITE AUTHORITY 21 NEGATIVE EXPERIENCES 34 IGNORANCE TECHNIQUES
53 NEGATIVE IMPACTS ON WOMEN
11 BIOLOGICAL RESOURCES INSUFFICIENT
28 NOBODY ID'D TO DO MAINTENANCE
10 LACK OF FABRICATION SKILLS
43 NO REGULATION 5 ACCESS CONFLICT
16 NEGATIVE ECOLOGICAL IMPACT
23/8 NO SYSTEM REPAIR/REPLACE 40 VANDALISM
12 INTERFERE W NAVIGATION CONFLICT
46 NO COST BENEFIT MONITORING
49 AID/GOVT RESISTANCE TO PROJECT
3 NO ON-SITE LONG-TERM EXPERT. 24 INNAPROPRIATE FAD LOCATIONS 48 UNABLE TO PROJECT VIABILITY
4 MATERIALS UNOBTAINABLE
OVERCOMING THESE BARRIERS
1 NOT HAVING DESIGN 6 NO REPLACEMENT $$ 35 LONGEVITY UPS $$ 39 LOST FADS=DEBRIS
33 RESISTANCE TO PROJECT FROM ON-SITE AGENCIES
9 LACK GOVT ENDORSEMENT, YET COMMUNITY EXPECTS OUTSIDE HELP
The Arrows Mean: THESE BARRIERS

Figure 3.--Expanded relationship of barriers.

Activities For Program Development

Next, the participants were asked to choose activities which would make significant contributions toward overcoming the barriers as depicted in the first network (Fig. 2). The trigger question for this part of the agenda was

> **What activities would contribute to overcoming the previously-identified barriers to designing and implementing a self-sustaining program of FADs in LDCs?**

These activities, which are listed and described briefly in Appendix B, are the building blocks for program design. This list of activities was then sorted into groups using a computer-assisted cluster algorithm through consensus response to the following question:

> **In designing and implementing a self-sustaining program of FADs, is activity A similar to activity B?**

The groups thus formed were identified with a generic label. This grouping is called an Options Field Network and identifies key segments of program design. These groups were then put in quasi-chronological order according to the question:

> **In designing a self-sustaining program of FADs, would you want to consider an activity from group A before considering an activity from group B?**

The resulting ordered **Options Field Network** is depicted in Figure 4. The logic of this figure is that consideration of activities in the upper left portion of the figure precede, chronologically, those to the right and in the lower portion of the figure.

Project Criteria

The next step in the planning process was for workshop participants to identify criteria for choosing a specific project site by using a "brain-writing" process; i.e., three focus groups of participants were asked to generate lists of criteria based on the following question:

> **In the context of implementing a FAD project in country X, what criteria would you use to choose a site for a FAD project?**

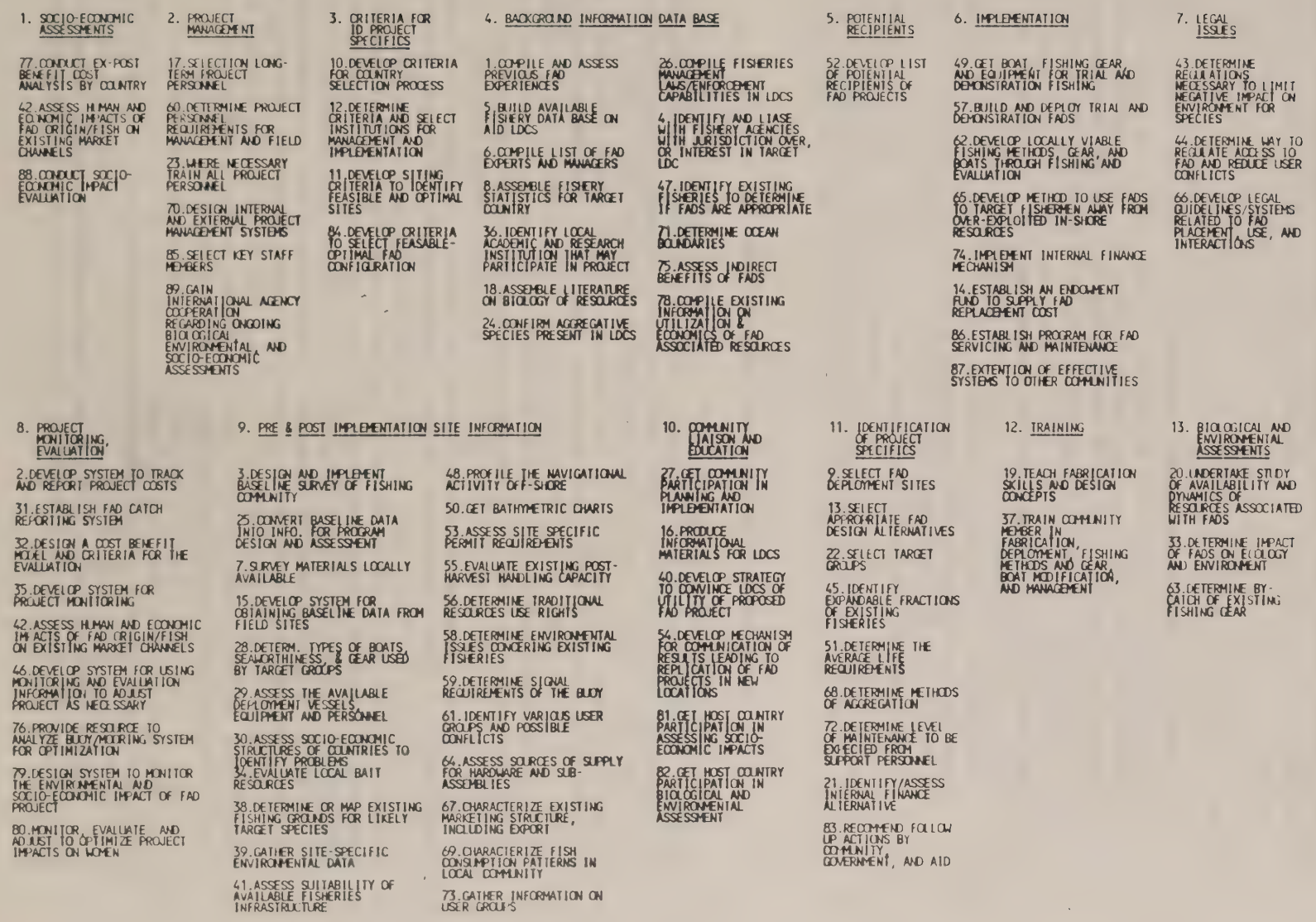
OPTIONS FIELD
1. SOCIO-ECONOMIC ASSESSMENTS
77.CONDUCT EX-POST BENEFIT COST ANALYSIS BY COUNTRY
42.ASSESS HUMAN AND ECONOMIC IMPACTS OF FAD ORIGIN/FISH ON EXISTING MARKET CHANNELS
88.CONDUCT SOCIO-ECONOMIC IMPACT EVALUATION
2. PROJECT MANAGEMENT
17.SELECTION LONG-TERM PROJECT PERSONNEL
60.DETERMINE PROJECT PERSONNEL REQUIREMENTS FOR MANAGEMENT AND FIELD
23.WHERE NECESSARY TRAIN ALL PROJECT PERSONNEL
70.DESIGN INTERNAL AND EXTERNAL PROJECT MANAGEMENT SYSTEMS
85.SELECT KEY STAFF MEMBERS
89.GAIN INTERNATIONAL AGENCY COOPERATION REGARDING ONGOING BIOLOGICAL ENVIRONMENTAL, AND SOCIO-ECONOMIC ASSESSMENTS
3. CRITERIA FOR ID PROJECT SPECIFICS
10.DEVELOP CRITERIA FOR COUNTRY SELECTION PROCESS
12.DETERMINE CRITERIA AND SELECT INSTITUTIONS FOR MANAGEMENT AND IMPLEMENTATION
11.DEVELOP SITING CRITERIA TO IDENTIFY FEASIBLE AND OPTIMAL SITES
84.DEVELOP CRITERIA TO SELECT FEASABLE-OPTIMAL FAD CONFIGURATION
4. BACKGROUND INFORMATION DATA BASE
1.COMPILE AND ASSESS PREVIOUS FAD EXPERIENCES
5.BUILD AVAILABLE FISHERY DATA BASE ON AID LDCS
6.COMPILE LIST OF FAD EXPERTS AND MANAGERS
8.ASSEMBLE FISHERY STATISTICS FOR TARGET COUNTRY
36.IDENTIFY LOCAL ACADEMIC AND RESEARCH INSTITUTION THAT MAY PARTICIPATE IN PROJECT
18.ASSEMBLE LITERATURE ON BIOLOGY OF RESOURCES
24.CONFIRM AGGREGATIVE SPECIES PRESENT IN LDCS
26.COMPILE FISHERIES MANAGEMENT LAWS/ENFORCEMENT CAPABILITIES IN LDCS
4.IDENTIFY AND LIASE WITH FISHERY AGENCIES WITH JURISDICTION OVER, OR INTEREST IN TARGET LDC
47.IDENTIFY EXISTING FISHERIES TO DETERMINE IF FADS ARE APPROPRIATE
71.DETERMINE OCEAN BOUNDARIES
75.ASSESS INDIRECT BENEFITS OF FADS
78.COMPILE EXISTING INFORMATION ON UTILIZATION & ECONOMICS OF FAD ASSOCIATED RESOURCES
5. POTENTIAL RECIPIENTS
52.DEVELOP LIST OF POTENTIAL RECIPIENTS OF FAD PROJECTS
6. IMPLEMENTATION
49.GET BOAT, FISHING GEAR, AND EQUIPMENT FOR TRIAL AND DEMONSTRATION FISHING
57.BUILD AND DEPLOY TRIAL AND DEMONSTRATION FADS
62.DEVELOP LOCALLY VIABLE FISHING METHODS, GEAR, AND BOATS THROUGH FISHING AND EVALUATION
65.DEVELOP METHOD TO USE FADS TO TARGET FISHERMEN AWAY FROM OVER-EXPLOITED IN-SHORE RESOURCES
74.IMPLEMENT INTERNAL FINANCE MECHANISM
14.ESTABLISH AN ENDOWMENT FUND TO SUPPLY FAD REPLACEMENT COST
86.ESTABLISH PROGRAM FOR FAD SERVICING AND MAINTENANCE
87.EXTENTION OF EFFECTIVE SYSTEMS TO OTHER COMMUNITIES
7. LEGAL ISSUES
43.DETERMINE REGULATIONS NECESSARY TO LIMIT NEGATIVE IMPACT ON ENVIRONMENT FOR SPECIES
44.DETERMINE WAY TO REGULATE ACCESS TO FAD AND REDUCE USER CONFLICTS
66.DEVELOP LEGAL GUIDELINES/SYSTEMS RELATED TO FAD PLACEMENT, USE, AND INTERACTIONS
8. PROJECT MONITORING, EVALUATION
2.DEVELOP SYSTEM TO TRACK AND REPORT PROJECT COSTS
31.ESTABLISH FAD CATCH REPORTING SYSTEM
32.DESIGN A COST BENEFIT MODEL AND CRITERIA FOR THE EVALUATION
35.DEVELOP SYSTEM FOR PROJECT MONITORING
42.ASSESS HUMAN AND ECONOMIC IMPACTS OF FAD ORIGIN/FISH ON EXISTING MARKET CHANNELS
46.DEVELOP SYSTEM FOR USING MONITORING AND EVALUATION INFORMATION TO ADJUST PROJECT AS NECESSARY
76.PROVIDE RESOURCE TO ANALYZE BUOY/MOORING SYSTEM FOR OPTIMIZATION
79.DESIGN SYSTEM TO MONITOR THE ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT OF FAD PROJECT
80.MONITOR, EVALUATE AND ADJUST TO OPTIMIZE PROJECT IMPACTS ON WOMEN
9. PRE & POST IMPLEMENTATION SITE INFORMATION
3.DESIGN AND IMPLEMENT BASELINE SURVEY OF FISHING COMMUNITY
25.CONVERT BASELINE DATA INTO INFO. FOR PROGRAM DESIGN AND ASSESSMENT
7.SURVEY MATERIALS LOCALLY AVAILABLE
15.DEVELOP SYSTEM FOR OBTAINING BASELINE DATA FROM FIELD SITES
28.DETERM. TYPES OF BOATS, SEAWORTHINESS, & GEAR USED BY TARGET GROUPS
29.ASSESS THE AVAILABLE DEPLOYMENT VESSELS, EQUIPMENT AND PERSONNEL
30.ASSESS SOCIO-ECONOMIC STRUCTURES OF COUNTRIES TO IDENTIFY PROBLEMS
34.EVALUATE LOCAL BAIT RESOURCES
38.DETERMINE OR MAP EXISTING FISHING GROUNDS FOR LIKELY TARGET SPECIES
39.GATHER SITE-SPECIFIC ENVIRONMENTAL DATA
41.ASSESS SUITABILITY OF AVAILABLE FISHERIES INFRASTRUCTURE
48.PROFILE THE NAVIGATIONAL ACTIVITY OFF-SHORE
50.GET BATHYMETRIC CHARTS
53.ASSESS SITE SPECIFIC PERMIT REQUIREMENTS
55.EVALUATE EXISTING POST-HARVEST HANDLING CAPACITY
56.DETERMINE TRADITIONAL RESOURCES USE RIGHTS
58.DETERMINE ENVIRONMENTAL ISSUES CONCERING EXISTING FISHERIES
59.DETERMINE SIGNAL REQUIREMENTS OF THE BUOY
61.IDENTIFY VARIOUS USER GROUPS AND POSSIBLE CONFLICTS
64.ASSESS SOURCES OF SUPPLY FOR HARDWARE AND SUB-ASSEMBLIES
67.CHARACTERIZE EXISTING MARKETING STRUCTURE, INCLUDING EXPORT
69.CHARACTERIZE FISH CONSUMPTION PATTERNS IN LOCAL COMMUNITY
73.GATHER INFORMATION ON USER GROUPS
10. COMMUNITY LIAISON AND EDUCATION
27.GET COMMUNITY PARTICIPATION IN PLANNING AND IMPLEMENTATION
16.PRODUCE INFORMATIONAL MATERIALS FOR LDCS
40.DEVELOP STRATEGY TO CONVINCE LDCS OF UTILITY OF PROPOSED FAD PROJECT
54.DEVELOP MECHANISM FOR COMMUNICATION OF RESULTS LEADING TO REPLICATION OF FAD PROJECTS IN NEW LOCATIONS
81.GET HOST COUNTRY PARTICIPATION IN ASSESSING SOCIO-ECONOMIC IMPACTS
82.GET HOST COUNTRY PARTICIPATION IN BIOLOGICAL AND ENVIRONMENTAL ASSESSMENT
11. IDENTIFICATION OF PROJECT SPECIFICS
9.SELECT FAD DEPLOYMENT SITES
13.SELECT APPROPRIATE FAD DESIGN ALTERNATIVES
22.SELECT TARGET GROUPS
45.IDENTIFY EXPANDABLE FRACTIONS OF EXISTING FISHERIES
51.DETERMINE THE AVERAGE LIFE REQUIREMENTS
68.DETERMINE METHODS OF AGGREGATION
72.DETERMINE LEVEL OF MAINTENANCE TO BE EXPECTED FROM SUPPORT PERSONNEL
21.IDENTIFY/ASSESS INTERNAL FINANCE ALTERNATIVE
83.RECOMMEND FOLLOW UP ACTIONS BY COMMUNITY, GOVERNMENT, AND AID
12. TRAINING
19.TEACH FABRICATION SKILLS AND DESIGN CONCEPTS
37.TRAIN COMMUNITY MEMBER IN FABRICATION, DEPLOYMENT, FISHING METHODS AND GEAR, BOAT MODIFICATION, AND MANAGEMENT
13. BIOLOGICAL AND ENVIRONMENTAL ASSESSMENTS
20.UNDERTAKE STUDY OF AVAILABILITY AND DYNAMICS OF RESOURCES ASSOCIATED WITH FADS
33.DETERMINE IMPACT OF FADS ON ECOLOGY AND ENVIRONMENT
63.DETERMINE BY-CATCH OF EXISTING FISHING GEAR

Figure 4.--Options field of FAD project activity.

These suggestions then were grouped into categories of similar criteria.

Project criteria groups

Community and government support.
Appropriate fishery locations.
Existing fisheries.
Adequate seafood markets and support infrastructure.
Availability of FAD construction and servicing infrastructure.
Suitable physical conditions for FADs.
Available fishing boats and equipment.
Avoidance of negative impacts.
Positive economic benefits.
Accessible to project personnel.
Financial support for project.

The individual criteria as developed in the brain-writing segment of the workshop are listed in Appendix C.

Workshop Evaluation

The workshop concluded with commentary by the participants on the successes and failures of the workshop. Most participants were impressed by the capabilities of the workshop planning process for compiling a comprehensive list of project requirements and melding those requirements into a relatively cohesive whole. Most also thought that the workshop process, in terms of interpersonal interactions and information forthcoming, was quite successful. However, many were uncertain whether the results would be specific enough to meet USAID planning objectives. A typical comment was that the workshop "organized" the elements necessary for designing a FAD project, but that fleshing out this skeleton into a program would take further work. David J. Mackett, as workshop facilitator, responded to some of these comments by noting that, while designing and deploying FADs probably was a relatively simple process, designing a system of **self-sustaining** FADs was much more complex. The workshop process contributed to a "holistic" approach toward program design which should guide the planners "downstream" from the workshop. A confidential evaluation of the workshop was also completed by the individual participants and reviewed by the facilitator and coordinators following the meeting.

WORKSHOP FOLLOW-UP

There was concern from the USAID sponsors and some participants that the workshop results would be difficult to

fit into USAID planning documents (especially the PID). The problem facing USAID in its decision on whether to implement a program of FADs in LDCs lies in the question of whether FADs will, overall, make a positive contribution to these communities and whether it is possible to make such a program self-sustaining. We can cite opposing opinions on each of these questions (Farman 1988), but in our judgment, FADs in appropriate environments work and can make a positive contribution to fishing communities and be self-sustaining. Therefore, we have put together a draft "problem definition," including a suggestion on project organization and program "logframe" akin to USAID documents. These contributions are discussed more fully in the next section. The workshop coordinators met with USAID officials immediately after the workshop to discuss program development details. The coordinators also prepared a rough draft of their report shortly after the workshop; portions of the draft report were compiled into the formal program document prepared separately by USAID. The final project documents were completed by NOAA F/IA, and the workshop participants were asked by NOAA F/IA to review the formal program outline and PID before it was submitted to USAID.

Categorization of Key Barriers

The workshop coordinators believed that grouping the barriers identified by the workshop participants was an important step in synthesizing the myriad information provided during the workshop. The most significant barriers (i.e., the barriers which bind most tightly) are the most imponderable and are based on the weakest technical knowledge. Previous fisheries development activities suggest that the socioeconomic aspects of projects are the most difficult to assess and design. Therefore, in the context of this program, key barriers include socioeconomic environment, economic benefits, and infrastructure and regulation. Other barriers, such as the biological environment or existing fisheries, may be defined or approximated based on previous experience. A key step in the project design phase of this program is to evaluate alternative project sites based on the best available information on these barriers, both from a general FAD experience perspective and from country- and site-specific experiences. There is no handbook of FAD project implementation which provides the answers to the questions raised by these barriers.

The site criteria (see Appendix C) also provide the basis for determining which countries would be feasible locations for FAD projects. A feasible country for implementing FAD projects would have demonstrable conditions for meeting the technical criteria that are required for a self-sustaining FAD project and do not include USAID-specific requirements for program implementation.

The next step would be to evaluate whether the barriers identified in the workshop are insurmountable at specific project locations. Activities for making these assessments must be split between evaluating country and project criteria, and conducting specific analyses of the project design.

It should be clear that a number of project activities could be undertaken to resolve these uncertainties. However, USAID is not proposing a research project on FAD effectiveness, although the first few project sites under this program should be chosen to provide more specific information on the applicability of this FAD model deployment. The essential elements of these project activities are discussed in the following paragraphs.

FAD Construction and Maintenance

There are two major aspects of FAD construction and maintenance: Can FADs be built suitable for local conditions with local materials, equipment, and labor; and do the institutional resources exist for developing a FAD maintenance program? It seems inevitable that these questions should be evaluated by a highly qualified FAD designer, in conjunction with a person similarly qualified in community dynamics.

Socioeconomic Environment

The socioeconomic environment is a wide-ranging condition, but the essential consideration is whether the community and local governments are responsive to economic change and the local socioeconomic organizational and technological level is such that FADs can be used fruitfully. We believe that FADs are simple enough to be implemented in many existing fishing communities. The real question being considered is whether there is social support for fisheries development. We do not believe that on-site investigation, rather than extensive analysis, is required for this issue.

Fisheries and Fishing Knowledge

The FADs may require a variety of new fishing techniques and gear and may conflict with existing fisheries or fisheries markets. Both conditions need to be evaluated carefully. On-site investigation by an experienced fisheries development expert is probably required.

Socioeconomic Benefits

Evaluating the a priori economic costs and benefits of a FAD program can probably be based on information developed in the

socioeconomic and fisheries investigations, i.e., it can be done off-site. However, the person doing this assessment should be integrated into the field team prior to on-site work.

Project Management

Developing the internal finance mechanism is going to be a difficult technical and political task. To a certain extent, evaluation of likely alternatives can be explored during the socioeconomic evaluation and in conjunction with the economic benefits assessment. However, the internal finance mechanism, and other issues of FAD system control, ultimately must be worked out on-site by the project manager in conjunction with local government, community organizations, fishermen, etc.

Program Considerations

Program managers need to be assured of the viability of the FADs and this program. The first task involves education: using a suitable educational vehicle based on existing fisheries. The second task is inherent in the USAID planning process, of which this report is a part. Both should be accomplished together.

Biological Environment

"Recruitment" of fish species to FADs is sufficiently pragmatic to view this problem as one of monitoring and evaluation, not project selection. Clearly some identifiable criteria for project selection involve these biological considerations, but the real problem is to develop a monitoring and evaluation system. This proposal suggests the incorporation of a centralized fisheries institution into the monitoring and evaluation phase of the project.

Oceanographic Environment

Although some criteria for site selection are generic, actual placement of FADs requires on-site expertise during project implementation.

Infrastructure and Regulation

Similar to the project management problems, the process of infrastructure and regulation must be worked on by the project manager during implementation.

Program Development Activities

Collectively, overcoming these barriers will require a small number of discrete program development activities:

(1) Final program design and presentation.
(2) Preliminary country screening.
(3) Program management selection.
(4) Final country selection.
(5) Project team development.
(6) Project implementation.
(7) Program monitoring and evaluation.

These activities include some USAID-mandated activities but also involve work specific to this program and are discussed more fully in other program development documents. The major program activities are arranged logically into a FAD project design (see Fig. 5).

These program development activities would involve the following particulars:

Final program design and presentation. Once the PID is completed in conjunction with the USAID-NOAA Fisheries consultant, the issue of acceptance of fisheries projects should be met head on. Part of this should involve an educational effort by NOAA Fisheries concerning existing FAD projects. Another part might include a USAID Bureau of Science and Technology (S/T) progress report on its interagency projects.

Preliminary country screening. When USAID has decided to proceed with the program, selection of countries where projects should be fielded can begin. We have identified three kinds of country selection criteria: 1) technical criteria based on existing knowledge of fisheries in USAID recipient countries, 2) technical criteria requiring site visits to potential project countries, and 3) USAID formal criteria. In this activity, we are speaking of the first and third of these selections. USAID will identify which countries are eligible for the project, and a team of NMFS F/IA and USAID S/T will consult with technical experts and USAID missions to identify countries which meet the first level of technical criteria. We anticipate that a number of countries may meet these criteria, and they should be ranked.

Program management selection. Program management within USAID should be developed in conjunction with the expertise necessary to implement the project. Essentially, this means that program management should involve some aspect of project management from the beginning. The project teams could be

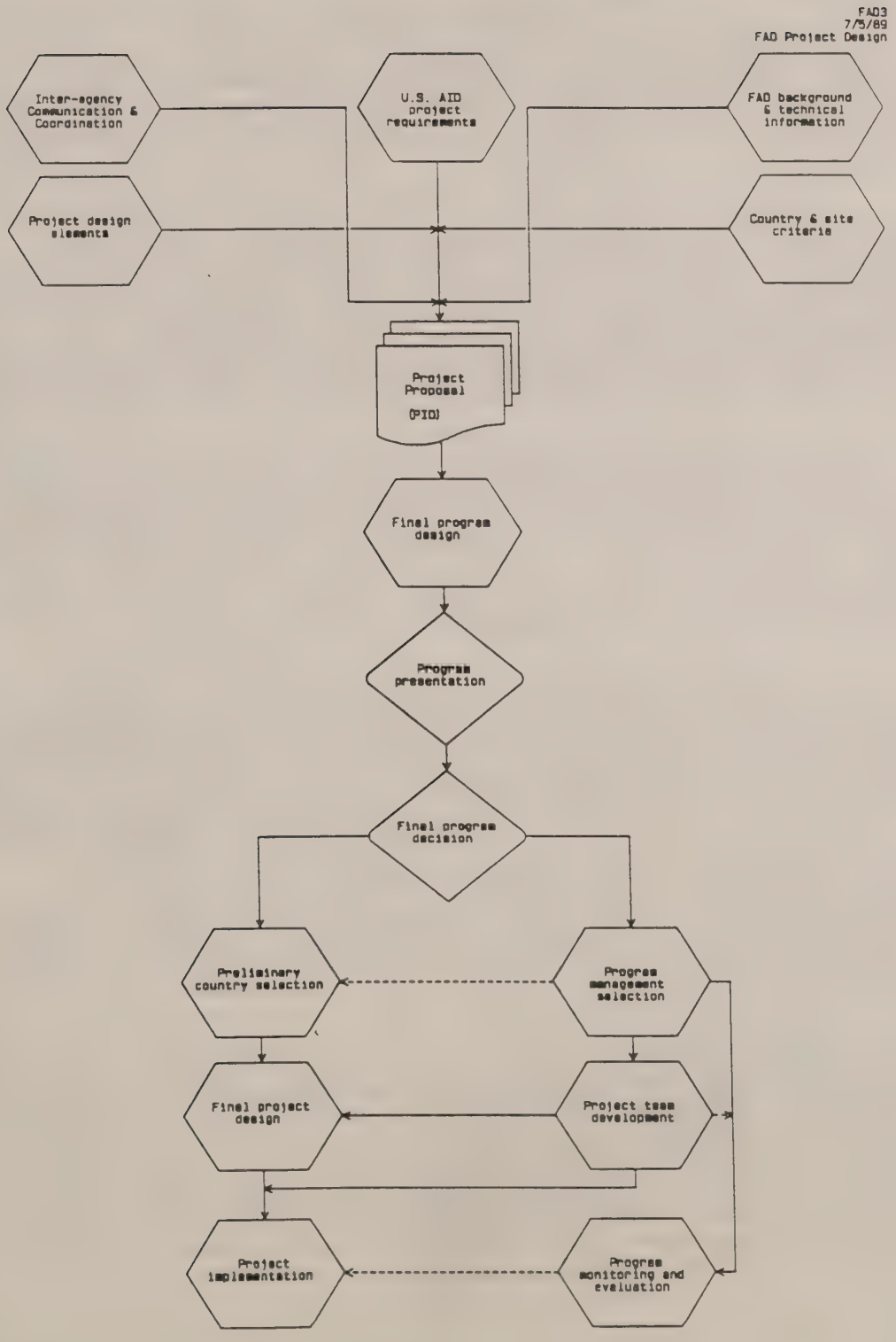

Figure 5.--FAD project design.

integrated into NMFS F/IA with other cooperating fisheries or marine resources institutions. However, program management will include communication between the field projects, assistance in project design and implementation, facilitation of monitoring and evaluation, and formal liaison with the cooperating institutions. The project design team will be part of program management.

Final country selection. Final country selection will require visits by field teams, and further formal USAID approvals. The field team should provide overall program leadership, and it may include the USAID program manager, a NMFS F/IA technical expert, and one or two consultants from cooperating fisheries or marine resource institutions. Five countries should be selected on technical criteria at this stage, with final selection according to USAID internal procedures.

Project team development. Project team development is formally a responsibility of USAID, unless a formal process of external implementation is worked out with a cooperating institution. However, in either case, project team development will require not only selection of members but also their integration into both the project design team and the institution that will monitor and evaluate the FAD projects.

Project implementation. Although we have identified a number of important elements in this report pertinent to project implementation, we can only suggest at this stage that the FAD projects will take approximately 5 years to implement. This includes initial project team logistics; developing a cooperative relationship with fisheries agencies in the recipient country, local government, and community liaison; FAD design, construction, and deployment; all the other aspects leading to FAD utilization; and initial project evaluation. The project should involve a midterm evaluation of progress, at both the country-site and cooperating institution levels.

Program monitoring and evaluation. The FAD program should involve an integration of on-site project implementation by individual project teams backed up by a technical relationship with a cooperating institution. Project implementation will involve technical details pertaining to FAD project design. This activity should be oriented toward developing the basis for consistent and thorough project evaluation through an ongoing monitoring program. This aspect of program development should be initiated at the same time as the project design.

Logframe

With this framework in mind, we have prepared a draft "logframe" in the manner used by USAID in organizing the project material. The logframe covers the goals, purpose, inputs, and outputs required to implement the program. This logframe will be supplemented substantially in the development of the USAID PID. This material appears in Appendix D.

Our perspective is that deploying a series of FADs in most ocean-accessible LDCs would not be very difficult. However, supporting a self-sustaining institutional environment for FADs is surely a different matter. In this case, development of institutions supporting FADs should be done in the context of existing community development programs and not limited to existing USAID projects. We do not have any particular suggestions for the institutional arrangements, since these should be done on a country-by-country basis (and probably on a community-by-community basis within countries), but program implementation should be undertaken in the context of the key barriers depicted in Figures 2 and 3.

CONCLUSION

Deploying FADs is not just a technological feat. The use and management of FADs raises many issues, from the biology and stock dynamics of the communities' fisheries to the economics and sociology of the communities themselves. The many previous experiences in FAD project design and in fisheries development should be evaluated carefully in the process of implementing the proposed USAID program of FADs.

The workshop represented by this report was an early stage in the program planning process. USAID and NOAA F/IA have since taken the program development further. Project implementation planning will be a further stage in the process. It will require a melding of technical, institutional, and community inputs in the context of the people who will have the authority to carry out the selected FAD projects. We believe that a key component of the USAID program should be to step beyond the pragmatic details of program and project implementation to the development of a program component which will assist in information and technology transfer from this program to other FAD programs. Central to this process should be thorough research on FAD performance, from a biological, logistical and engineering, and socioeconomic basis.

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APPENDIXES

Appendix A.--Complete listing of FAD project barriers.

The barriers are listed in the order they were brought up by the participants. We have taken the liberty of editing the language of some of the barriers as stated by the participants at the workshop to ensure that each is phrased as a barrier (e.g., "fabrication skills" was edited to become "lack of fabrication skills"). Asterisks identify the barriers ranked highly by the participants in a tabulated voting. Each barrier includes a brief clarification of its meaning summarized from the workshop discussion.

Rank *s	No.	Barrier
*****	1	NEEDING A FAD BUOY/MOORING DESIGN. Although "off-the-shelf" designs exist for FADs, it is usually necessary to develop a buoy configuration (including the appendages) and mooring design consistent with local conditions. Failing to make these modifications to existing designs and failing to identify someone to make these modifications are included in this barrier.
****	2	LACK OF KNOWLEDGE FOR SELECTION OF FAD SITES TO PRODUCE A SUITABLE HARVEST. What FADs do in terms of aggregating fish depends crucially on the local oceanographic and fishery conditions. Furthermore, not knowing where FADs will work to aggregate fish appropriate to the marketing or social needs of people.
*	3	LACK OF ON-SITE, LONG-TERM EXPERTISE IN A NUMBER OF DIFFERENT AREAS. Not having a local fishing tradition with methods, boats, and fishing gear adaptable to FAD fishing. Lacking experienced on-site personnel responsible for project management.
*	4	FAD MATERIALS AND SUPPLIES UNAVAILABLE OR UNOBTAINABLE. Not having materials available locally, and not having sufficient foreign exchange to allow importation of supplies.

Appendix A.--Continued.

Rank *s	No.	Barrier
*	5	CONFLICTS DUE TO ACCESS RIGHTS. Not establishing how rights to fish at potentially overused FADs will be granted. Similarly, conflicts may arise over access to ocean sites where the FADs will be.
	6	INSUFFICIENT HARD CURRENCY GENERATED BY PELAGIC FADS TO UNDERWRITE REPLACEMENT COST. The FAD may contribute much toward the subsistence of people using the FADs and their harvest but not generate cash available for replacement of the FADs. The social (i.e., nonmarket) value of the FAD may exceed its strict monetary value.
*	7	INADEQUATE EQUIPMENT OR BOATS AVAILABLE TO FISHERMEN. Not having sufficient material resources to use the FADs once deployed. This barrier may affect the choice of FAD sites in recipient countries.
**	8	LACK OF INTERNAL FINANCE MECHANISM. Not meeting the costs of maintenance and repair from contributions of time, funds, user fees, government support, etc. [The participants cross referenced this barrier to Barrier number 23 below.]
***	9	LACK OF ACCEPTANCE/ENDORSEMENT OF FAD PROGRAM GOALS BY GOVERNMENT, AND COMMUNITY'S EXPECTATION OF GOVERNMENT HELP. Not matching the community expectation of government support with actual government resources. (The government may not accept or endorse the program as fully as anticipated by the community once knowledge of the FAD project becomes widespread.)
*	10	LACK OF FABRICATION SKILLS. No adequately skilled local work force for construction, maintenance, and replacement of FADs.

Appendix A.--Continued.

Rank *s	No.	Barrier
***	11	INSUFFICIENT NATURAL/BIOLOGICAL RESOURCE TO SUPPORT DEVELOPMENT. Not knowing if there are enough fish to support development, or whether a seasonal pattern in abundance will destabilize production and thus hamper development.
	12	CONFLICTS ARISING FROM FADS INTERFERING WITH NAVIGATION AND VICE VERSA. No assurance that collision by passing vessels with FADs can be avoided--either the vessel or the FAD may be damaged, raising safety, replacement, and liability problems.
	13	NO ON-SITE AUTHORITY FOR FAD PROJECTS. Not having a project manager with sufficient authority and labor expertise to be able to assign the work of FAD repair and replacement. However the barrier is also applicable to a wide range of project activities during the life of a FAD program.
	14	POTENTIAL FOR INEQUITIES DUE TO OWNERSHIP PATTERNS. FADs may attract (or be seen to attract) fish away from other areas fished by people who do not have access to the FADs. The economic analysis of FADs frequently looks at the direct benefits without considering the allocation of those benefits across the community.
	15	NOT IDENTIFYING SCALE OF FISHERIES TO BE USED BY FADS . . . SMALL-SCALE, SPORT, OR LARGE-SCALE-INDUSTRIAL USAGE. Inappropriate placement of FADs resulting from not tailoring deployment to specific types of users.

Appendix A.--Continued.

Rank *s	No.	Barrier
****	16	NEGATIVE ECOLOGICAL IMPACT. Possible overfishing of forage species or exploited stocks and their juveniles. Possible negative impact of FAD structures on the environment. Although FADs have been considered environmentally benign, they do change behavior within the food chain and therefore may have a negative ecological impact which must be anticipated.
*	17	LACK OF INFORMATION ABOUT USER GROUPS. Not knowing enough about who will use the FADs and what their needs are. Failure to identify social problems of FAD programs before deployment.
	18	LACK OF INFORMATION ABOUT SOCIAL SYSTEM WITHIN A COMMUNITY RESULTING IN NON-RESOURCE PROBLEMS. Inadequate social siting of FAD project. An otherwise viable project may conflict with the local social system.
	19	NO VESSELS FOR SERVICING (MAINTAINING) FADs. Not having the type of vessel that can get to the site and service the FAD. (This includes functions such as examining the top-side moorings, changing the batteries for lamps, replacing appendages placed under the FAD to increase attractiveness to baitfish, etc.).
	20	LACK OF INFORMATION FOR ESTIMATING THE NUMBER OF FADS NECESSARY TO MAKE THE PROJECT VIABLE. Not knowing the extent of the resource base or recruitment to the FADs, putting in too many FADs for the available resource, or not putting in enough to demonstrate effectiveness.
	21	NEGATIVE EXPERIENCES WITH PREVIOUS FISHERY PROJECTS AND GOVERNMENT PROGRAMS. Not being able to overcome bad experiences with other government programs.

Appendix A.--Continued.

Rank *s	No.	Barrier
	22	CONFLICT BETWEEN OLDER AND NEW FISHERMEN. Resentment against newcomers who, with the FADs, are using an easier method of catching fish than traditional non-FAD fishing practices.
***	23	LACK OF FINANCIAL MANAGEMENT SYSTEMS TO PROVIDE FOR PREVENTIVE MAINTENANCE OR REPLACEMENT. A central problem for a self-sustaining system of FADs will be a financial allocation system which can provide timely resources for FAD maintenance and replacement. [Cross-referenced to Barrier 8.]
**	24	INAPPROPRIATE FAD LOCATIONS RESULTING IN POOR CATCHES, FREQUENT LOSS OR USER CONFLICTS. The "siting" problems for FADs in terms of their ability to effectively aggregate fish are substantial. Frequently considerable experimentation with local conditions may be required before a FAD can be adequately moored and attract desirable fish species.
	25	POSSIBLE IMPACT OF FADS ON TRADITIONAL FISHING ORGANIZATIONS. Interference with previous group or individual fishing practices.
	26	LACK OF DATA ON OCEANOGRAPHIC CONDITIONS. The bathymetry and ocean current data needed for proper engineering of FADs may be inadequate.
	27	[Deleted by consensus]
*	28	MAINTENANCE PERSONNEL NOT IDENTIFIED FOR PROJECT FADS. Failing to define who will take care of FAD maintenance, with the general expectation that someone else (e.g., the government) will do it, resulting in no responsibility and inaction for maintenance and continued deployment and thus not a **self-sustaining** FAD).

Appendix A.--Continued.

Rank *s	No.	Barrier
	29	OVERESTIMATING THE NUMBER OF BOATS THAT CAN EFFECTIVELY USE THE FADS DEPLOYED. Too many boats removing fish from the FAD in a short time. The result is the open access condition of over-capacity which already plagues many fisheries.
	30	INTERFERENCE FROM FOREIGN FISHING FLEETS. Not being able to regulate or control fishery near FADs by foreign fleets.
	31	CONFLICT WITH MARINE MAMMALS (DOLPHINS). Not being able to avoid interaction with protected species. In tuna handline fishing, dolphins sometimes become a nuisance by taking bait. Fishermen may retaliate. FADs have not been particularly associated with marine mammals, but it is a consideration which should be addressed when FADs are deployed.
	32	LACK OF INFORMATION TO DEVELOP OR SELECT PROPER INSTITUTIONAL BASE. Not knowing which institutions are viable and suitable to run or own the FADs. If the FAD program is to be self-sustaining, then indigenous institutions must be able to operate the FAD program after the project is completed.
**	33	RESISTANCE TO FAD PROGRAM FROM EXISTING LOCAL GOVERNMENTS AND/OR ON-SITE AGENCIES. Not being able to resolve turf problems, working in the backyard of local, national, and international agencies already involved with fishery development in the area.
	34	IGNORANCE OF FAD FISHING TECHNIQUES AND GEARS. Successful FAD fishing may require techniques with which locals are not familiar.

Appendix A.--Continued.

Rank *s	No.	Barrier
	35	LONGEVITY OF FADS . . . LONG-TERM FADS NOT COST EFFECTIVE. Some FAD designs can greatly reduce repair and replacement costs by being long-lasting, but these might be so costly as to be unaffordable for replacement. The choice between frequent deployments (replacements) and long-term permanence should be based on local conditions.
	36	NO ENGINEERING/LOGISTICS FEEDBACK FOR SYSTEM. Assuming everything will not be right the first time, changes and improvements cannot be made without feedback to the experts. The FAD program should develop a communications link between those who control deployment of FADs on the local level with those who are investigating the technical aspects of FADs on a regional, national, or international level.
*	37	INABILITY TO PROJECT FAD COMPETITION WITH EXISTING FISHING SITES OR PRACTICES. Lack of biological knowledge to assess the extent to which FADs will remove fish from other fishing locales or fisheries.
	38	LACK OF A STABLE POPULATION WITH TRADITIONS AND MOTIVATIONS FOR FISHING. For example, fishermen may be too mobile to stay in one area and use FADs or may be unwilling to give up traditional practices.
	39	MARINE DEBRIS FROM LOSS OF FADS. The least expensive FADs may easily become debris. Plastics used as appendages on FADS may also become a marine debris problem.
	40	LACK OF TECHNIQUES TO PREVENT THEFT AND VANDALISM. FAD thefts, poaching, and malicious or inadvertent damage.

Appendix A.--Continued.

Rank *s	No.	Barrier
	41	LACK OF MARKETING INFRASTRUCTURE TO HANDLE EXCESS FISH. Inadequate seafood storage, transportation, and markets to support fishery expansion.
	42	UNAVAILABILITY OF PLATFORMS FOR FAD DEPLOYMENT. Not having vessels with the capacity to deploy FADs. Such vessels may (depending on FAD design) need to be much larger than the vessels needed to fish the FADs.
**	43	NOT REGULATING WHO CAN FISH THE FADS. Lack of authority and power to enforce any necessary rules.
**	44	LACK OF KNOWLEDGE OF PREVIOUS FAD EXPERIENCES ON SAME OR SIMILAR SITES. The FAD project team needs to develop sufficient local contacts to insure that information from the previous local experiences or from similar areas is incorporated into the FAD design and deployment stages of the project.
*	45	CONFLICT BETWEEN RESOURCE USER GROUPS. People fishing on FAD-aggregated fish may conflict with others exploiting the same or similar resources.
*	46	LACK OF SYSTEM TO ESTIMATE PROJECT COSTS AND BENEFITS. FAD projects tend to be biologically or engineering oriented, frequently in a research mode, with the fiscal side underdeveloped.
	47	PROBLEM OF CAPTURE OF JUVENILE-SIZED FISHES ON FADS. Impaired biological recruitment to the larger population of a fish species may be caused by removal of the juveniles which tend to be more plentiful around FADs, e.g., catches of small yellowfin tuna at FAD locations may hurt a neighboring handline fishery for larger yellowfin tuna.

Appendix A.--Continued.

Rank *s	No.	Barrier
***	48	INABILITY TO PROJECT VIABILITY OF THE PROJECT. Not enough information up front to convince potential beneficiaries that project could be viable.
**	49	NOT OVERCOMING AID AND/OR LDC GOVERNMENT INDIFFERENCE OR RESISTANCE TO PROJECT. Not obtaining complete (genuine) institutional support for the project.
	50	INAPPROPRIATE LEVEL OF PARTICIPATION BY HEADQUARTERS. Headquarters fisheries or development agency tries to make decisions that should be made locally, or in contrast, ignores the project.
**	51	LACK OF IDENTIFICATION OF LDC OCEAN BOUNDARIES. Conflict over jurisdiction of sites for FAD deployment and use.
**	52	USE OF TECHNOLOGY INAPPROPRIATE FOR TARGET GROUP. Technology beyond the skill or resources of the target group that will build and deploy the FAD.
	53	NEGATIVE IMPACTS OF FAD-ORIENTED FISHERY DEVELOPMENT ON WOMEN. Social impacts of development may be different for men than for women, and the impacts on women could be negative. USAID has become particularly sensitive to the impact of economic development on women as their lives change from traditional to more industrial or commercial lifestyles. A potential impact of FADs would be short-term supply gluts (followed by shortages) in the processing sector which frequently has been the major source of fisheries employment for women.
	54	LACK OF PHYSICAL SITE SELECTION CRITERIA. Not knowing the distance from port, sea and weather conditions, etc., that the FAD deployment and FAD users will have to contend with (the non-biological environmental criteria for FAD placement).

Appendix A.--Continued.

Rank *s	No.	Barrier
	55	UNAVAILABILITY OF LOCAL MANUFACTURING, CONSTRUCTION OR ASSEMBLY FACILITY. Some FAD designs may require technological resources greater than those available in local communities.
	56	LACK OF ENFORCEMENT OF RULES CONCERNING FAD USE. FADs must be protected from physical abuse (such as vessels tying up) which would reduce their lifespan, and other rules may be required to regulate fishing at FADs.
*	57	LACK OF COUNTRY SELECTION CRITERIA. Eligible countries outnumber those that can be served. Selection of countries to receive FADs should be objectively determined.
	58	DIFFICULTY OBTAINING PERMITS AND APPROVALS FOR FADS. FAD deployments frequently require permits because of the potential interaction between FADs and ocean navigation.
	59	LACK OF INSTITUTIONAL ARRANGEMENT FOR LONG-TERM MONITORING OF BIOLOGICAL CONSEQUENCES OF FAD DEPLOYMENT. USAID projects tend to be pragmatic, while the long-term monitoring of project benefits tend to be left to other agencies, such as local universities and international fisheries agencies.
	60	LACK OF FISHERY SUPPORT INFRASTRUCTURE E.G., RAMPS/ICE. If FADs are successful in increasing the supply of fish, then the question comes whether sufficient fishery infrastructure is available convenient to FAD sites to optimize the use of FAD harvests.

Appendix A.--Continued.

Rank *s	No.	Barrier
*	61	NOT IDENTIFYING OPTIONS FOR PROJECT IMPLEMENTATION BY U.S. OR FOREIGN INSTITUTIONS AND ORGANIZATIONS. Not recognizing options to join existing development projects, to coordinate with related efforts, or to use volunteer organizations.

Appendix B.--Complete listing of activities to overcome barriers.

Activities which would make significant contributions toward overcoming the network of barriers previously identified by the workshop participants. The original contribution of the participant proposing the activity is presented in capital letters, while a brief clarification follows in regular text. These activities are not presented in priority order.

Number	Activity
1	COMPILE AND ASSESS PREVIOUS FAD EXPERIENCES.
	Publications, gray literature.
2	DEVELOP SYSTEM TO TRACK AND REPORT PROJECT COSTS.
	Assigning price tags to each step.
3	DESIGN AND IMPLEMENT BASELINE SURVEY OF FISHING COMMUNITY.
	Statistically valid socioeconomic baseline on fishing population and all types of user groups.
4	IDENTIFY AND LIAISE WITH FISHERY AGENCIES WITH JURISDICTION OVER, OR INTEREST IN, TARGET LDC.
	Get in touch with relevant organizations.
5	BUILD AVAILABLE FISHERY DATA BASE ON U.S. AID COUNTRIES.
	Organizations such as the FAO have written strategy papers on fishery development, preliminary stock assessments, bibliographies, and fishery profiles that would be useful. This activity would be to compile this existing information, rather than to conduct new research.
6	COMPILE LIST OF FAD EXPERTS AND MANAGERS.
	Experts on FAD design, biology, and all other relevant fields, considering the broadest range of fields and expertise.
7	SURVEY LOCALLY AVAILABLE MATERIALS.
	If something needed is not available locally and must be imported, it can be a very major drawback.

Appendix B.--Continued.

Number	Activity
8	ASSEMBLE FISHERY STATISTICS FOR TARGET COUNTRY. From multiple sources, assemble what is known already about catch, effort, revenue, size composition, and participation.
9	SELECT FAD DEPLOYMENT SITES. Sites, in the broadest sense, from the target countries to the general areas to the actual spots in the ocean.
10	DEVELOP CRITERIA FOR COUNTRY SELECTION PROCESS. Many more countries will qualify than can be used. Develop criteria for how to choose between them.
11	DEVELOP SITING CRITERIA TO IDENTIFY FEASIBLE AND OPTIMAL SITES. Needs to be done before one can do activity 9.
12	DETERMINE CRITERIA AND SELECT INSTITUTIONS FOR MANAGEMENT AND IMPLEMENTATION. The way to select the best group to make the project happen. (It could be one of the international centers or U.S. institutions.)
13	DETERMINE APPROPRIATE FAD DESIGN ALTERNATIVES. Look at past experience and come up with best possible design.
14	ESTABLISH AN ENDOWMENT FUND TO SUPPLY FAD REPLACEMENT COSTS. Assign some of the initial capital to an interest-bearing account to cover continuing costs.

Appendix B.--Continued.

Number	Activity
15	DEVELOP SYSTEM FOR OBTAINING BASELINE DATA FROM FIELD SITES. Collecting existing data, as well as new data, on anthropology, market, fishery, or socioeconomic factors. This activity is meant to cover the broadest range of information from oceanography to the economy at a national level.
16	PRODUCE FAD INFORMATIONAL MATERIALS FOR LDCS. Simple, clear, concise public relations material for the project.
17	SELECTION LONG-TERM PROJECT PERSONNEL. An institution is needed for backup, but individuals who will follow through with the projects need to be involved at a very early stage and should be chosen carefully.
18	ASSEMBLE BIOLOGICAL LITERATURE RELATING TO FISH RESOURCES. That is, those resources that are likely to be harvested by project. Assemble basic background literature on stock assessments and biological information, including models of existing FAD fisheries.
19	TEACH FABRICATION SKILLS AND DESIGN CONCEPTS. FADs need to be designed with local manufacturing capabilities in mind; a self-sustaining FAD system will require local manufacturing skills.
20	UNDERTAKE AVAILABILITY STUDY OF RESOURCE DYNAMICS ASSOCIATED WITH FADS. Review literature and collect additional data as needed on the dynamics of fish aggregations, replacement rates, research on the impact on lower trophic levels, etc. A lot of new work needs to be done.

Appendix B.--Continued.

Number	Activity
21	IDENTIFY/ASSESS INTERNAL FINANCE ALTERNATIVE. This would be armchair work developing a menu of financing alternatives and assessing them based on information from baseline studies (see activity 74 for implementation).
22	SELECT TARGET GROUPS. Identify the types of people or groups who will use the FADs.
23	WHERE NECESSARY, TRAIN ALL PROJECT PERSONNEL. Everyone involved in design and implementation (people in activity 19 included) needs to be trained in the logistical requirements for deploying and sustaining a network of FADs.
24	CONFIRM PRESENCE OF DEMONSTRABLY AGGREGATIVE SPECIES IN LDCS. If USAID does not underwrite the biological research, then past experience with tunas in the LDCs must be used. (However, USAID may not be absolute about not underwriting any biological research, if that research is very applied rather than basic.) This activity would ensure very early on that tunas are available for aggregation.
25	CONVERT BASELINE DATA TO INFORMATION FOR PROGRAM DESIGN AND ASSESSMENT. A large amount of data must be converted to information that can be used for project design and assessment.
26	COMPILE INFORMATION ON FISHERIES MANAGEMENT LAWS/ENFORCEMENT CAPABILITIES IN LDCS. If regulatory measures are planned, then as a part of country selection, one must know what rules are already in place.

Appendix B.--Continued.

Number	Activity
27	GET COMMUNITY PARTICIPATION IN PLANNING AND IMPLEMENTATION. As part of the selection process, try to find and involve the people essential to the project.
28	DETERMINE TYPES OF BOATS, THEIR SEAWORTHINESS, AND THE GEAR EMPLOYED BY TARGET USER GROUPS. After choosing the country, survey the groups to obtain details and location of available gear and boats for use in fine-scale FAD placement decisions.
29	ASSESS THE AVAILABLE DEPLOYMENT VESSELS, EQUIPMENT, AND PERSONNEL. These considerations drive FAD design, because a boat larger than a fishing vessel is usually needed for FAD deployment. Otherwise, a special design that will work with smaller boats is needed.
30	ASSESS SOCIOECONOMIC STRUCTURES OF SELECTED COUNTRIES TO IDENTIFY POTENTIAL PROBLEMS. Look for characteristics in social system that will impair the project.
31	ESTABLISH FAD CATCH REPORTING SYSTEM. Evaluate the project after FAD deployment.
32	DESIGN A COST BENEFIT MODEL AND CRITERIA FOR EVALUATION. Includes economics, and beyond, to assess all impacts and benefits (including ecological ones). (Activity 2 develops a system. This activity includes the utilization of such a system.)
33	DETERMINE IMPACTS OF FADS ON ECOLOGY AND ENVIRONMENT. Using available data, assemble a general assessment of impacts based on best available information.

Appendix B.--Continued.

Number	Activity
34	EVALUATE LOCAL BAIT RESOURCES. FAD fishing is not only a troll fishery but a drift-bait or live-bait fishery, where bait can be limiting.
35	DEVELOP SYSTEM FOR PROJECT MONITORING. Needs to be built in, so that the monitoring proceeds as the project proceeds.
36	IDENTIFY LOCAL ACADEMIC AND RESEARCH INSTITUTIONS THAT MAY PARTICIPATE IN THE PROJECT. Get help from local researchers and involve them in the planning and evaluation stages of the FAD project.
37	TRAIN COMMUNITY MEMBERS IN FABRICATION, DEPLOYMENT, FISHING METHODS AND GEAR, BOAT MODIFICATION, AND MANAGEMENT. Distinct from training project personnel, train the FAD builders and users.
38	DETERMINE OR MAP EXISTING FISHING GROUNDS FOR LIKELY TARGET SPECIES. Originally stated to occur after a country is chosen. This activity could also be cast at an earlier planning level to ensure that suitable fishing grounds are available.
39	GATHER SITE-SPECIFIC ENVIRONMENTAL DATA. Wind, tides, currents, etc., from existing data and local knowledge, rather than from new research.
40	DEVELOP STRATEGY TO CONVINCE LDCS OF UTILITY OF PROPOSED FAD PROJECT. During every aspect of informing the public about the project, consider the social and political sensibilities of the target community and institutions.

Appendix B.--Continued.

Number	Activity
41	ASSESS SUITABILITY OF AVAILABLE FISHERIES INFRASTRUCTURE. At the site-selection stage, after a country is chosen. (Based on port location and facilities, as well as markets.)
42	ASSESS HUMAN AND ECONOMIC IMPACTS OF FAD-CAUGHT FISH ON EXISTING MARKET CHANNELS. Determine what impacts may be caused a new influx of fish, in excess of previous supply from the existing system. Identify means to alleviate negative impacts.
43	DETERMINE REGULATIONS NECESSARY TO LIMIT NEGATIVE IMPACTS ON SPECIES ENVIRONMENT. Limit the number of fishers and type of gear, assuming there is no traditional system of regulation.
44	DETERMINE WAY TO REGULATE ACCESS TO FAD AND REDUCE USER CONFLICTS. Set up a buy-in system or user fee to keep others from using FADs.
45	IDENTIFY EXPANDABLE FRACTIONS OF EXISTING FISHERIES. Placement can be tailored for target group, from strictly small-scale fishers to more commercial (more mobile) fishers to sport fishers. Expandable means not having to start from scratch, because boats and fisheries are already there.
46	DEVELOP SYSTEM FOR USING MONITORING AND EVALUATION INFORMATION TO ADJUST PROJECT AS NECESSARY. As things proceed, may find that part of the original plans and projections are incorrect. System must adapt as project proceeds. This activity calls for watching the projects on an ongoing basis.

Appendix B.--Continued.

Number	Activity
47	IDENTIFY EXISTING FISHERIES TO DETERMINE IF FADS ARE APPROPRIATE. FADs may be "appropriate" or "inappropriate" for a variety of biological and socioeconomic reasons; existing fisheries should give clues to what will and will not work.
48	PROFILE THE NAVIGATIONAL ACTIVITY OFFSHORE. Examine the navigation hazard of FADs and surface and subsurface vessels.
49	GET BOAT, FISHING GEAR, AND EQUIPMENT FOR TRIAL AND DEMONSTRATION FISHING. For transfer of the technology to community, getting equipment to site can be more of a problem than expected. [To get a country's support, it could demonstrate a trial FAD to some officials. Get the easiest system together for a demonstration.] The gist of this activity is to introduce the technology.
50	GET BATHYMETRIC CHARTS. Useful in deciding if potentially useful sites exit for the deployment of FADs in a given country.
51	DETERMINE THE AVERAGE FAD LIFE REQUIREMENTS. A 9-month throw away or a 5-year megasystem. It is not just what materials are available; it is what is affordable and cost effective in each community.
52	DEVELOP LIST OF POTENTIAL RECIPIENTS OF FAD PROJECTS. After the selection criteria have been determined, apply them to potential countries and draw up a ranked list based on site-specific criteria.
53	ASSESS SITE-SPECIFIC PERMIT REQUIREMENTS. With local authorities, determine any requirements.

Appendix B.--Continued.

Number	Activity
54	DEVELOP MECHANISM FOR COMMUNICATION OF RESULTS, LEADING TO REPLICATION OF FAD PROJECTS IN NEW LOCATIONS. Emphasize the self-generation of self-sustaining FADs.
55	EVALUATE EXISTING POST-HARVEST HANDLING CAPACITY. If the fish supply is expanded beyond the level of immediate consumption, there must be a facility for the excess.
56	DETERMINE TRADITIONAL RESOURCE USE RIGHTS. Try to ensure that FAD placement is sensitive to local social conditions.
57	BUILD AND DEPLOY TRIAL AND DEMONSTRATION FADS. May have value in promoting the project to local communities and institutions.
58	DETERMINE ENVIRONMENTAL ISSUES NOW OF CONCERN RELATIVE TO EXISTING FISHING ACTIVITIES. Contact user groups, government agencies, or interest groups to determine what problems may already exist with the type of fishing to be applied at FADs.
59	DETERMINE SIGNAL REQUIREMENTS OF THE BUOY. FAD may be illuminated in a variety of ways (lights, reflectors, flags, etc.) and determination of these signals depends on the cost effectiveness of the alternatives.
60	DETERMINE PROJECT PERSONNEL REQUIREMENTS FOR MANAGEMENT AND FIELD. For a proposed project, determine the type and number of people to run the project and for field teams.

Appendix B.--Continued.

Number	Activity
61	IDENTIFY VARIOUS USER GROUPS AND POSSIBLE CONFLICTS. Similar to several other activities (such as activity 22). The emphasis here is on conflicts, i.e., on the problems which will likely arise as a new technology changes not only the fishing practices of the FAD users but may also affect others in the area as well as conditions in the markets.
62	DEVELOP LOCALLY VIABLE FISHING METHODS, GEAR, AND BOATS THROUGH FISHING AND EVALUATION. What works in one place may not work in another. Some methods are transplantable, but in most cases, a lot of time is required to make things work in a new location.
63	DETERMINE BY-CATCH OF EXISTING FISHING GEAR. Find out what the by-catch from current fisheries for use in evaluating potential ecosystem impacts.
64	ASSESS SOURCES OF SUPPLY FOR HARDWARE AND SUBASSEMBLIES. Before deciding on a design, find the best sources, and the best prices, especially for what is not available locally.
65	DEVELOP METHOD TO USE FADS TO TARGET FISHERMEN AWAY FROM OVEREXPLOITED INSHORE RESOURCES. FADs may give the opportunity to harvest a less-exploited resource than those currently fished.
66	DEVELOP LEGAL GUIDELINES AND SYSTEMS RELATED TO FAD PLACEMENT, USE, AND INTERACTIONS. Address the legal conflicts that could arise, the system of permits, and what happens when a boat runs down a FAD: survey the whole legal situation and propose alternative legal systems.
67	CHARACTERIZE EXISTING MARKETING STRUCTURE, INCLUDING EXPORT FROM TARGET AREA. See what the situation is before making changes (similar to activity 42). This provides a baseline for examining what impacts the FAD program might have.

Appendix B.--Continued.

Number	Activity
68	DETERMINE METHODS OF AGGREGATION.
	FAD design considerations; e.g., size and configuration, underwater lights and sound, netting to hang in the water below the FADs, etc.
69	CHARACTERIZE FISH CONSUMPTION PATTERNS IN LOCAL COMMUNITY.
	Target group may not like to eat fish species caught at FADs.
70	DESIGN INTERNAL AND EXTERNAL PROJECT MANAGEMENT SYSTEMS.
	Internal refers to within country; external is between on-site and off-site.
71	DETERMINE OCEAN BOUNDARIES.
	Refers to ocean jurisdiction, not water mass or biotic boundaries. The feasibility of deploying and maintaining FADs, as well as using them, may depend on the political jurisdictions which surround the FADs, including the usual routes to and from FADs to port.
72	DETERMINE LEVEL OF MAINTENANCE TO BE EXPECTED FROM SUPPORT PERSONNEL.
	Decide if the local infrastructure will be able to maintain the proposed design, then choose the design accordingly.
73	GATHER INFORMATION ON USER GROUPS.
	This helps design the FAD program to local interests and capabilities and also may help ameliorate user conflicts.
74	IMPLEMENT INTERNAL FINANCE MECHANISM.
	The idea behind this program of FADs is that they be self-sustaining, which means not dependent on out-of-country finances (except perhaps through export earnings). The means to finance FAD deployment and maintenance is a major institutional activity required for this program.

Appendix B.--Continued.

Number	Activity
75	ASSESS INDIRECT BENEFITS OF FADS. Such as less time and fuel used to catch an equivalent amount of fish, decreased sea time in dangerous water. These indirect benefits may help assuage concerns by local officials or communities that FADs are simply increasing fishing power without any real savings for the community.
76	PROVIDE RESOURCES TO ANALYZE BUOY-MOORING SYSTEM FOR OPTIMIZATION. Determine alternatives in light of durability and cost.
77	CONDUCT EX-POST BENEFIT COST ANALYSIS BY COUNTRY. Ensure that the project has an "after life."
78	PREPARE, FROM EXISTING INFORMATION, REPORTS ON UTILIZATION AND ECONOMICS OF FAD-ASSOCIATED RESOURCES. Consolidate existing socioeconomic information to provide guidance on cost-benefit approaches to FAD development.
79	DESIGN SYSTEM TO MONITOR THE ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS OF FAD PROJECT. (Similar to Activity 77, with a broader emphasis.)
80	MONITOR, EVALUATE, AND ADJUST TO OPTIMIZE PROJECT IMPACTS ON WOMEN. Responding to USAID priorities and to insure that FADs have an equitable impact on all parts of the community.
81	GET HOST COUNTRY'S PARTICIPATION IN ASSESSING SOCIOECONOMIC IMPACTS. Attempt to integrate project evaluation into host country's long-term planning process.
82	GET HOST COUNTRY'S PARTICIPATION IN BIOLOGICAL AND ENVIRONMENTAL ASSESSMENT. Attempt to transfer technological and scientific skills required for monitoring, evaluating, and modifying FADs.

Appendix B.--Continued.

Number	Activity
83	RECOMMEND FOLLOW-UP ACTIONS BY COMMUNITY, GOVERNMENT, AND USAID. Preplan the kind of work which will be required when the project is "completed" and FADs are expected to be self-sustaining.
84	DEVELOP CRITERIA TO SELECT FEASIBLE-OPTIMAL FAD CONFIGURATION. Identify key economic variables for alternative FAD designs and deployments.
85	SELECT KEY STAFF MEMBERS. Staff members at the program and project level must be selected soon enough that they can be trained in the activities required for the FAD program **and** play a role in planning the actual implementation of the FAD program in their locality.
86	ESTABLISH PROGRAM FOR FAD SERVICING AND MAINTENANCE. Do not assume that existing fisheries personnel should or can handle the ongoing implementation of the FAD project.
87	EXTEND EFFECTIVE SYSTEMS TO OTHER COMMUNITIES. Develop communication of project results so that the spin-off benefits of the FAD project are extended.
88	CONDUCT SOCIOECONOMIC IMPACT EVALUATION. Although the FAD program is directed toward specific benefits for the localities where they are deployed, expanding the knowledge of the socioeconomic impact of FADs may play a major role in future deployments.
89	GAIN INTERNATIONAL AGENCY COOPERATION REGARDING ONGOING BIOLOGICAL, ENVIRONMENTAL, AND SOCIOECONOMIC ASSESSMENTS. Utilize existing international institutions to expand the knowledge base about FADs.

Appendix C.--Complete listing of criteria, by category, for selecting a FAD site.

Community and government support (11)

Community and/or local government support.
Cooperative and/or local official involvement and approval.
FADs to be located within territorial waters.
Fishing access rights already established.
Fishermen willing to implement FAD project.
Local fishing community and government sufficiently organized to support project.
Location where FAD project can be successful and encourage local government initiative.
Government and community infrastructure.
No existing community conflicts.
Cooperative local population.
Positive attitude by local officials and industry.

Appropriate fishing conditions (9)

Close to areas of nutrient upwelling.
Existence of aggregatable species.
Sites with fishable stocks.
Offshore area with existing tuna (or other aggregatable species).
FAD catch per unit effort (CPUEs) exceed non-FAD CPUEs.
Close to aggregatable species.
Along migratory routes for pelagic species.
Existence of aggregatable species.
Availability and proximity of aggregatable pelagic species.

Existing fishery (8)

Close to users.
Population of fishermen who would benefit from FADs (increased capture of fish; lower risk; lower costs).
Potential tourist sport fishery.
Economy ripe for new initiative.
Active small-scale fishery already in place.
Existing fishing activity.
Fishing community with pelagic fisheries experience.
Fledgling fishery already in existence.

Appendix C.--Continued.

Adequate seafood markets and support infrastructure (8)

Close to seafood distribution centers (markets).
Market infrastructure capable of handling increased landings.
Landing and transport infrastructure capable of increased production.
Local tradition of pelagic seafood consumption.
Established or develop handling capability.
Adequate processing, distribution, and marketing systems.
Close to population centers to speed distribution of catch.
Transportation, storage and marketing infrastructure.
Potential to export catch (local or foreign).

Availability of FAD construction and servicing infrastructure (8)

Close to FAD service vessel home ports.
FAD equipment and materials available.
Local availability of FAD construction materials.
Local availability of FAD materials and expertise.
Supply infrastructure available.
Local personnel with required skills.
Proximity to sizable community with required infrastructure.
Proximity to project personnel and support equipment.

Suitable physical conditions for FADs (6)

Appropriate oceanographic and meteorological conditions.
Environmental conditions suitable for FAD mooring.
Oceanographic-physical environment conducive to FAD deployment.
Areas where currents and tides are suitable (however defined).
Physical-oceanographic setting suitable for FAD deployment.
Bottom contour idea for mooring FADs.

Available fishing boats and equipment (6)

Boats and equipment available to use FADs.
Close to established fisheries.
Level of vessel technology.
Suitable oceanographic conditions (appropriate for existing vessel technology).
Site with appropriate vessels.
Fishing gear adaptable to FAD fishing.

Appendix C.--Continued.

Avoidance of negative impacts (6)

Site not in conflict with other "aggregators."
Sites sufficiently offshore to deter "undesired" fishermen.
FADs not in conflict with existing travel patterns.
FADs not in navigational areas, "kapu" [restricted] areas, etc.
FADs not where natural aggregators already exist.
Sufficient fish stocks to avoid detraction from non-FAD catch.

Positive socioeconomic benefits (3)

Women in processing and marketing sectors.
Positive benefit-cost ratio.
Sites where travel costs are high
(i.e., positive benefit-cost ratio).
Distance between port and FADs "reasonable."

Accessible to project personnel (3)

Site accessible to extension, monitoring, and evaluation.
FAD sites relatively close to each other.
Essential living conditions for project personnel.

Financial support for project (2)

USAID mission support and financing.
Local financing available.

Appendix D.--Preliminary *Program Identification Document.*

NOAA Support for Fish Aggregating Devices in Less Developed Countries

Project Setting

In 1987, NOAA Fisheries and the U.S. Agency for International Development (USAID) began discussions on ways to improve USAID's fisheries assistance to less developed countries (LDCs). While a number of cooperative agreements exist between USAID and other U.S. institutions interested in fisheries (including NOAA Fisheries), this initiative centered on the possibility of developing a program of fish aggregating devices (FADs) within the context of USAID's typical project design.

Early in 1989, NOAA Fisheries completed a project concept paper for USAID which identified the key components of a FAD program. The concept paper called for further refinement of the idea by NOAA Fisheries, and initial project development. The paper describes the proposed program in greater detail.

Problem Definition

Efforts to utilize ocean resources in LDCs have been hampered by overexploitation of nearshore resources and by neglect of offshore fisheries because of existing harvest technologies. However, a number of pelagic fishery resources (i.e., fish not limited to a particular bottom habitat) offer opportunities for fishery development. The pelagic tuna fishery resources of the world have proven to be extremely robust and, more importantly, relatively immune to overharvesting on a localized basis. (Overexploitation on oceanic and regional bases can occur, requiring international management. Even in the case of ocean overharvesting, small-scale utilization of offshore tuna resources can still be a viable development option.)

A number of pelagic resources, especially tunas, have been shown to be more efficiently harvested through the use of FADs, various kinds of fishing buoys and floating platforms which apparently congregate these species in locations where they can be captured more easily, economically, and safely. Furthermore, FADs have been shown to work with a wide variety of materials and technologies and in a number of different fishing conditions.

Appendix D.--Continued.

Although in a few cases FAD use has led to localized overharvesting, the negative environmental and fishery impacts of FADs appear to be extremely limited. (FADs differ from artificial reefs in that FADs do not enhance fish stocks and instead increase catchability, whereas some artificial reefs may enhance the stocks. As opposed to artificial reefs, FADs do not change the basic ecology of the habitat they occupy. The problem with many FAD programs, especially as part of international aid programs, is that they frequently have not been self-sustaining, i.e., fishing communities have not developed internal finance, maintenance, and replacement mechanisms for the FADs, and either the FADs are not replaced when lost or there is a continuing claim on foreign assistance.

However, FADs could be domestically maintained in a number of ways, and a major part of this project will be to develop guidelines for such maintenance. This could include a long-term government commitment to the FAD program (as in Hawaii), where general tax revenue is used on a regular basis to maintain an extensive system of FADs. Alternatively, FAD use could be taxed directly or indirectly through excise taxes or license fees, or FADs could become the property of villages, local fishing cooperatives, or companies who then become responsible for their maintenance.

Other problems with the use of FADs include FAD design, deployment, and servicing; FAD locations (oceanographic, topographical, and fisheries); fisheries techniques; fisheries institutions (such as access rights and competition between fisheries); fisheries markets; and fisheries monitoring and evaluation. None of the solutions to these problems is simple, and some extend beyond the needs of the immediate project site.

Finally, although the body of knowledge about FADs and their use is considerable, this knowledge has not been integrated into USAID fisheries projects. Throughout the less developed world, fisheries development faces the problem of overharvesting available fishery resources or in proposing fishing techniques of inappropriate scale. Collating the whole range of FAD information indicated by this report on a project-by-project basis is not cost effective. It would be better developed on a general scale, demonstrated in appropriate locations, monitored and evaluated, and extended to a wider range of locations as site-specific knowledge expands.

Appendix D.--Continued.

Program Goals

The primary goal of this project is to improve the coastal fisheries of LDCs on a self-sustaining basis through the development of FADs. The secondary goal of this project is to improve USAID capabilities in enhancing coastal fisheries through the development of FAD expertise. Meeting these goals will increase the potential fishery resources can contribute to the well-being of small-scale fishing communities in the LDCs. This project proposes a means of addressing the immediate needs of small fishing communities in LDCs through the implementation of networks of FADs, while meeting the long-term needs of fisheries managers in evaluating experiences with FADs and developing a feedback system for improving elements of FAD program design. These project objectives would be met by the development of a technical resource of FAD design, including buoy construction, methods for mooring, deployment, and servicing.

Project Description

The project will have three components: 1) implementation of FADs in appropriate sites in two countries, 2) development of a technical resource on FAD program requirements (design, etc.), and evaluation of the FADs from a biological and socioeconomic perspective. To accomplish these components, the project should include the development of a cooperative relationship between USAID, NOAA Fisheries, and the implementing agency (which might be NOAA Fisheries or another fisheries institution, such as an applied marine resources institute).

Preliminary Logical Logframe

Introduction of Fish Aggregating Devices into Small-Scale Fisheries

GOAL: To improve the coastal fisheries of LDCs on a self-sustaining basis through the development of FADs.

To improve USAID capabilities in enhancing coastal fisheries through the development of FAD expertise.

Appendix D.--Continued.

PURPOSE: To develop an integrated approach for enhancing small-scale fisheries through the systematic implementation of FADs in LDCs designed to

(1) increase fisheries yields while avoiding over-fishing existing fisheries;

(2) increase fisheries employment and incomes; and

(3) create the means for FAD design, construction, deployment, and maintenance by LDCs and fisheries communities without external assistance.

OUTPUTS:

(1) FAD systems in at least two sites in two countries.

(2) Training in FAD design, construction, deployment, and maintenance, and in FAD fishing techniques at each site.

(3) USAID-NOAA Fisheries information center containing technical references on FAD fisheries.

(4) Liaison with NOAA Fisheries for monitoring and evaluating FAD projects.

(5) NOAA Fisheries evaluation of FAD projects within 5 years of implementation.

INPUTS:

USAID

Program management.
Grant funding of FAD project teams and implementation costs.
Grant funding of NOAA Fisheries non-personnel costs (including site visits during implementation and monitoring period).

Appendix D.--Continued.

NOAA Fisheries	
	Personnel and associated research costs for project evaluation.
Host countries	
	Participation of fisheries officials in FAD projects.